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BONAPARTE'S REPORT.

As foreshadowed in his remarks at the annual dinner of the Society of Naval Architects and Marine Engineers in New York in November last, Secretary Bonaparte, of the navy department, has reversed himself regarding naval increase. He now thinks that the country should have a navy commensurate with its size which, of course, means a great navy. In a plea for an adequate navy he says:

"Provided our naval strength be sufficient to retain command of the sea, we are absolutely safe from invasion, and consequently escape the burdens of a vast military establishment which bear upon all the great powers of the European continent; but if we have not a sufficient navy the oceans to the east and west of us, instead of serving as bulwarks for defense become highways for invasion. The extensive steam merchant marines which serve the commerce of the world are no less available to transport men and munitions of war, and they place our shores within a week's or at least a fortnight's march of a powerful army from any one of the great military countries of the world, a danger rendered far more serious by the fact that an enemy coming by water is restricted to no line of advance ascertainable beforehand and may choose for aggression any point of our coast line which seems the most vulnerable.

The pecuniary burden imposed on each inhabitant of the United States for the maintenance of the navy may be estimated roughly, but with a fair approximation of accuracy, at one-third of that borne by each inhabitant of Great Britain and Ireland, and the burden of personal service to the like end at about one-seventh. Expressed in figures we may say that the cost of the navy amounts to about $1.33 per annum for each inhabitant of the United States and that about six men out of every 10,000 inhabitants are at present bound by law to naval service. Surely such burdens as these, or even some very slight increase of these burdens, will be accepted without reluctance or murmur by the patriotism and good sense of the American people."

Mr. Bonaparte reviews and commends the reports of the personnel board except in minor particulars and declares that the result, if the suggestions be adopted by congress, will be the more rapid advancement of officers. He advises grouping the work of the department under four sections with well-defined powers and responsibilities. He urges the creation of at least two vice admirals. He defends and explains the work of the general board and advises placing the chiefs of bureaus on the military assignment standing.

The secretary declares that hazing has been virtually abolished at the naval academy, while the standard of scholarship has been raised. Specific legislation to settle disputes as to titles in the navy is urged. He declares that the lack of sufficient enlisted men is due to the stringency of the requirements and not to lack of applicants, but he declares the situation is improving. He scores applications for pardons for desertion. He suggests publishing the names of all places that discriminate against the uniform and its wearers.

The secretary commends the naval militia, but urges the establishment of a system of large reserves of trained seamen and advises paying such reserves at least $250 a year each on service, the number being limited to 20,000. Increase the number of captains to forty is approved. The work on battleship design and submarines is reviewed. It is urged that provision be made for a reasonable increase in the number of battleships because of changed conditions in Europe.

BATTLESHIP VERMONT'S TRIAL.

When the battleship Vermont, from the yards of the Fore River Ship Building Co., Quincy, Mass., successfully completed all her government trials at sea, including a four-hour run at full power, a twenty-four-hour endurance test, and the usual turning and backing maneuvers, her forward deck from stem to bridge was incased in ice, as the result of a thirty-six-hour trip in a northwest gale with zero temperature.

When she reached the city Rear Admiral Hemphill, chairman of the naval trial board, notified the secretary of the navy that the behavior of the ship had been excellent. In the four-hour full-power run, the Vermont averaged 18.33 knots an hour. In the twenty-four-hour test the average speed was 17.43 knots an hour and the H. P. 14,500. The requirements called for an average of 18 knots at full power and 13,000 H. P. at two-thirds speed.

The trials were held under the most severe conditions encountered thus far by a government vessel in her official tests. The tests were all completed in four days, which is the shortest period in which a battleship has been put through her paces.

From the time the Vermont started until she finished the weather was very stormy. The four-hour run was made on a south-southwest course, and when it ended, Cape Ann was about thirty miles on the starboard beam.

Without stopping, the Vermont be-

gan her twenty-four-hour test, with the thermometer falling rapidly and the wind rising just as fast. It was impossible to see more than a mile or two ahead, owing to the thick mist from the cold weather, but the vessel was swung around to the eastward again and a course laid toward Mount Desert Rock. A number of runs were made over this course in the twenty-four hours, and all the time the big seas were tumbling over the bow and the flying spray was freezing as it fell. No one on board dared to venture out of the superstructure forward.

The lifelines, which ran round the deck and were about an inch in diameter at the start, grew in the night, as they were covered with ice, until they were a foot thick. The ship's bell was almost hidden by the ice, while the forward mast was white to the truck.

Naval Architects and Marine Engineers

An unfortunate misplacement of a few lines of type on page 25 of last week's issue made the concluding paragraph of Prof. James E. Denton's paper on the Hudson River Day Line's steamer, New York, and Stevenson Taylor's opening discussion upon the paper unintelligible. After the line "or from the Nicholson log, volume 9, is only about 21.5 miles," the true reading should be:

It also appears that the highest revolutions did not occur during the period of highest steam pressure, and the highest speed of boat did not coincide with the highest revolutions per minute.

These inconsistencies, which are caused by variable conditions of current and channel show that long distance river trials of speed, while affording opportunity for sensational records, are an unsatisfactory means of determining the true capacity of the boat.

DISCUSSION.

Vice President Stevenson Taylor (in the chair)—It is a great pleasure to receive a paper from Prof. Denton, and we are sorry he is not here himself to present the paper. If there is no discussion upon this paper I would like for the sake of the record to call attention to the fact that the steamer New York, as described by Prof. Denton, is different from the steamer as at first constructed; in other words, there were 30 ft. added to her length, put in at the widest part of the boat, which has changed the result some, but not very materially, when you consider the change in the boat and the greater carrying capacity. The dimensions originally, in 1887, were: Length of hull on water line, 300 ft., now 330 ft.; beam on water line, 40 ft., now 40 ft.; draught from top of keel during tests, 5 ft. 10 in., now 6 ft.; displacement, 1,000 gross tons, now 1,240 gross tons; block co-efficient, 0.584, now .50; outside diameter of paddles, 30 ft. 2 in., now 29 ft. 10 in.; diameter to center of trunnions, 27 ft., now 27 ft; width of paddles, 12 ft. 9 in., now 12 ft. 6 in.; dip of paddles, 4 ft. 2 in., standing, 4 ft. 6 in. running, now 4 ft. 5 in.

The tables illustrating the New York's performance are published herewith.

TABLE A.—RESULTS OF PROGRESSIVE SPEED TRIAL.

Trial.	Direction.	Revolutions per minute.	Boiler pressure, lbs. per sq. in.	Vac. ins.	M.E.P.	Indicated horsepower.	Statute miles per hour. Speed of boat along shore.	Mean tide by opposite runs.	Tide by curve.	True speed, col. 8 +col. 10.	Slip per cent at cen. of trunnions.
1	2	3	4	5	6	7	8	9	10	11	12
			Throttled.								
No. 1.	S.	15.4	37	28.0	10.43	529	11.72	0.38 N.	0.65 N.	12.37	16.70
	N.	15.87	37	28.0	10.65	540	12.84		0.10 N.	12.74	16.73
			Throttled.								
No. 2.	S.	19.78	38	28	15.40	973	16.83	1.01 S.	0.93 S.	15.90	16.62
	N.	20.80	39	28	15.56	1,035	15.60		1.14 S.	16.74	16.51
			Wide open.								
No. 3.	S.	25.53	36	26	28.17	2,297	21.70	1.42 S.	1.31. S.	20.39	17.15
	N.	25.84	32	26	27.97	2,310	19.10		1.48 S.	20.58	17.38
			Wide open.								
No. 4.	S.	27.59	50=43	24.5	32.26	2,843	23.08	1.78 S.	1.63 S.	21.45	19.35
	N.	28.18	48=47	24.0	34.80	3,132	19.96		1.76 S.	21.72	20.05

TABLE B.—SPEED DATA OVER COURSE OF 0.85 STATUTE MILES.

Trial.	Direction.	Time.	Stop watch interval, minutes.	Revolutions per minute.	Total revolutions recorded.	$(\Delta t) \times R$	Statute miles per hour. Tide constant slip.*	Speed of boat along shore.
1	2	3	4	5	6	7	8	9
			Δt	r	R			
	S.	h. m. s. 10:03:00 10:07:21		15.40	67	274.0		11.72
No. 1.		4:21	4.35				0.38	
	N.	10:23:00 10:26:58		15.87	63	266.0		12.84
		3:59	3.97			540.0		
	S.	10:57:40 11:00:42		19.78	60	196.2		
No. 2.		2:02	3.033				1.01	16.82
	N.	11:15:35 11:18:51		20.80	68	206.2		15.60
		3:16	3.270			402.4		
	S.	11:29:40 11:32:01		25.53	60	160.2		
No. 3.		2:21	2.350				1.42	21.70
	N.	11:46:00 11:48:40		25.84	69	162.1		19.10
		2:40	2.670			322.3		
		12:03:30 12:05:43		27.59	61	159.1		23.07
No. 4.		2:13	2.210				1.78	
	N.	12:17:40 12:20:13		28.18	72	155.8		19.96
		2:33	2.555			314.9		

*Tide $= \dfrac{60\,L\,(Ra - Rw)}{(\Delta tw)Ra + (\Delta ta)Rw}$, L = length of course = 0.85 statute mile.

Depth of water 48 to 65 ft.

PROF. PEABODY'S PAPER.

Two papers were next read in conjunction—"Personal Impressions of Ship Model Towing Stations Abroad" by Prof. C. H. Peabody, of the Massachusetts Institute of Technology and "The Experimental Tank of the University of Michigan" by Prof. H. C. Sadler. As the substance of Prof. Sadler's paper was published in the MARINE REVIEW of June 7 it will only be necessary to give here Prof. Peabody's paper which was as follows:

Among the various objects of interest to the naval architect and ship builder which the writer had the good fortune to see during the summer just past, were the several European stations for towing ship models, which were then in operation; and it is thought that a non-technical statement of personal impressions might be interesting to the members of this society. The importance of such stations is so well recognized and the general arrangements are so well known from memoirs in the proceed-

ings of learned societies and from articles in scientific periodicals that a rehearsal of such matter would be pedantic and tedious; a statement of general dimensions and of dates of installation will be appended to this article for any that may be curious and may not have the information at hand.

The first station visited was the admiralty tank at Hasla, which was established in 1886, in succession to the original tank at Torquay, the date of the establishment of the original tank being 1872. Through the kindness of Sir Philip Watts, K. C. B., chief constructor to the admiralty, the writer had the privilege of meeting there R. E. Froude, Esq., and of seeing the station under his guidance. Of the simplicity of manner and the scientific enthusiasm of this leading exponent of experimental and theoretical investigations in the realm of naval architecture it would be impossible to speak adequately without offending the characteristic reserve of his countrymen.

The first impression and the last impression of the station itself was the admirably practical adaptation of the means to the end. Nothing was lacking that could add to the convenience and certainty of the work of the station, but nothing was done for the sake of appearance.

The carriage of this station was designed to be drawn by a wire rope and as its span is about 20 ft., it was necessary that it should be at once light and stiff. This result was accomplished by constructing a girder of pine wood, the individual members being made in the form of hollow boxes cemented and screwed together. There is some thought of applying electric traction for the wire rope and steam engine at this station and also at the station at Spezia, which closely resembles it; the station at Dumbarton follows the design of the original tank at Torquay and has the track suspended from the roof so that the span is much less and the carriage is so small and light that there is no intention of using electric traction. All other stations use electric traction much as at the Washington station.

The apparatus for applying and measuring the force required to tow a model is largely made of mahogany and gives the impression of nice discrimination in the selection of materials and proportions to give delicacy and certainty to the operation of the apparatus. It all has clearly been made under the eye of the master who knew what he desired to do and how best to do it. When first installed the car was unduly affected by longitudinal vibrations of the wire tow rope, an influence which did not affect the original design with its small and light car; in passing it may be mentioned that the car at Dumbarton is so small and light as to escape this influence. To obviate this defect a hydraulic cylinder and piston were interposed between the rope and the car and no further difficulty was experienced. An advantage of a light carriage as is found in all European stations is the fact that the rails, which are truly well laid and occasionally inspected, do not show evidence of any extraordinary care, such as grinding to reduce minute roughnesses.

As is well known, the models at

TABLE C.—INDICATOR CARDS OF PROGRESSIVE TRIAL.
Mean Heights of Cards. Scale 39.46 lbs. = 1 in.

	Trial No. 1. North. Top.	Trial No. 1. North. Bottom.	Trial No. 1. South. Top.	Trial No. 1. South. Bottom.	Trial No. 2. South. Top.	Trial No. 2. South. Bottom.	Trial No. 2. North. Top.	Trial No. 2. North. Bottom.	Trial No. 3. South. Top.	Trial No. 3. South. Bottom.	Trial No. 3. North. Top.	Trial No. 3. North. Bottom.	Trial No. 4. South. Top.	Trial No. 4. South. Bottom.	Trial No. 4. North. Top.	Trial No. 4. North. Bottom.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1......	0.25	0.27	0.25	0.28	0.35	0.42	0.37	0.44	0.681	0.757	0.661	0.757	0.763	0.869	0.818	0.935
2......	0.24	0.28	0.25	0.28	0.36	0.42	0.38	0.45	0.681	0.752	0.663	0.754	0.767	0.877	0.790	0.977
3......	0.24	0.27	0.25	0.28	0.36	0.40	0.36	0.42	0.685	0.747	0.667	0.757	0.758	0.873	0.799	0.977
4......	0.25	0.28	0.25	0.28	0.35	0.42	0.37	0.43	0.674	0.754	0.659	0.752	0.766	0.864	0.786	0.982
5......	0.25	0.28	0.25	0.28	0.36	0.42	0.37	0.45	0.670	0.738	0.665	0.753	0.764	0.872	0.785	0.977
6......	0.25	0.28	0.24	0.27	0.36	0.42	0.37	0.42	0.667	0.763	.....	.....	.....	.....	0.779	0.969
7......	0.25	0.28	0.24	0.27	....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....
Average	0.27		0.262		0.387		0.402		0.714		0.709		0.8175		0.881	
M. E. P.	10.65		10.43		15.4		15.86		28.17		27.97		32.26		34.76	

TABLE D.—CONTINUOUS RUN DESBROSSES STREET TO POUGHKEEPSIE.
May 28, 1903. High Water Governors Island 8:48 A. M.

Points.	Time	Difference of time.	Distance statute miles. Total by Nicholson log.	Distance statute miles. Differences. Log.	Distance statute miles. Differences. Chart.	Speed, miles per hour. Tide by columns (3), (5) and (6).	Speed, miles per hour. Of boat, along shore.	Speed, miles per hour. Of boat, corrected for tide.	Average revolutions per minute from continuous counter.	Average horsepower cards each 15 minutes.	Average boiler pressure.	Average vacuum, inches.	Average depth of water, feet.	Number of bends in river.	Speed and horsepower from curves of progessive speed trial for revolutions of column 10. True speed, miles per hour.	Speed and horsepower from curves of progessive speed trial for revolutions of column 10. Indicated horsepower.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	h. m. s.	m. s.														
Desbrosses St.	8:42:00	.....	0.0	.....	.....	......	.....	.....	......	.....	...	.....	...	..	.....	....
42d St.	8:51:00	9:00	2.5	2.5	2.88	2.53N.	19.20	16.67	......	.....	35*	26.5	60	1	.....	....
129th St.	9:04:00	.....	6.2	.....	.....	......	.....	.....	......	.....	33	25.5	34	0	.....	....
Fort Wash. Pt.........	9:10:00	.....	8.15	.....	.....	......	.....	.....	......	.....	...	.....	...	0	.....	....
Yonkers	9:26:00	35:00	13.60	11.1	13.12	3.46N.	22.50	19.04	25.5*	2240*	37*	25.3*	37*	1	20.37	2250
Tarrytown Lt.	9:53:20	27:20	23.10	9.5	10.36	1.89N.	22.72	20.83	26.8	2620	39	25.3	33	1	21.12	2670
Rockland Lt.	10:07:20	.....	27.65	.....	.....	......	... .	.....	......	.....	...	.....	28	..	.....	....
Haverstraw	10:21:00	.....	.....	.....	.....	......	.....	.....	......	.....	...	.....	37	..	.....	....
Stony Pt.	10:28:00	34:40	34.55	11.45	12.35	1.55N.	21.37	19.82	26.4	2664	43	25.0	36	1	20.90	2550
West Pt.	10:56:20	28:20	44.65	10.10	12.00	4.02N.	25.42	21.40	27.7	2843	42	25.3	110	4	21.60	2975
Newburgh	11:19:40	23:20	52.90	8.25	8.40	0.39N.	21.59	21.20	28.13	2979	42	25.3	81	4	21.82	3125
New Hamburgh	11:36:15	.....	58.70	.....	.....	......	.....	.....	......	.....	40	25.2	...	..	.....	....
Pougkkeepsie	11:57:20	37:40	66.30	13.40	15.10	2.71N.	24.04	21.33	27.5	2867	39	25.2	60	2	21.50	3115
	3:13:20	.....	66.3	66.3	74.21	......	.....	.....	26.63†	.....	...	.....	....	..	.....	....

*The figures in these columns are the averages for the intervals between the points for which the tide is calculated.
†This figure is for the whole interval from Desbrosses St. to Poughkeepsie.
Average speed of boat along shore, Desbrosses St. to Poughkeepsie, 23.05 statute miles per hour.
Average flood tide, Desbrosses St. to Poughkeepsie, 2.46 statute miles per hour.
Average speed through water, Desbrosses St. to Poughkeepsie, 20.59 statute miles per hour.

this station (and for that matter at all European stations) are made of paraffine hardened by a small admixture of beeswax. The outside is molded roughly in modeling clay leaving plenty of stock to allow for cutting to the proper form; and the interior is determined by a basket framework of wooden splints, covered with calico painted with modeling clay to prevent the passage of the hot paraffine. When the model is cast, the liquid paraffine is run in slowly and begins to set at the bottom; water is filled in as fast as the paraffine sets, to aid in cooling and to counteract the hydraulic pressure of the paraffine. The water being the heavier fluid must be kept at a less height and this further avoids washing away the clay painted on the calico. Though the method of profiling models to the correct water lines has frequently been described, and though the most essential feature has been brought out prominently, I am tempted to try a description, as the reality was so much more impressive than any description. To begin with, let it be brought to mind that the model is mounted upside down on a platen like that of a planer, but which can be raised to the proper height for cutting any water line. The revolving cutters are set at a fixed height and are drawn apart or brought together simultaneously by a pantograph arrangement that is controlled by tracing the water lines on a drawing at a convenient scale. The tracer is a circle which at its proper scale simulates the revolving cutter; or if the ship's lines are contracted the tracer becomes an ellipse. Now since it is difficult to draw or maintain a truly straight base line on any drawing, the difficulty is met by springing a wooden straight line to the base line. The tracing part of the pantograph has two guided points, one resting against the wooden base line and the other controlled by the hand of the operator, who in effect callipers the half widths of the water lines and transfers them at the proper scale to the cutters, so that the model is straight whether the drawing is so or not, and has the correct form as determined by the water lines. The model is always cut from the middle towards an end (bow or stern) so that the operator, in tracing a water line, is likely (if in error) to make the model too full; a fault that can be readily corrected by repeating the operation or may be remedied by the model-maker when he cuts away redundant material. But the tracer has a further advantage in that the platen is driven by hydraulic pressure that can be controlled by opening a by-pass valve; or rather, the by-pass is always open and the model at rest until the operator partially shuts the by-pass by pressure on a foot lever and so drives the model at any desired rate. The tracing is done by a hand wheel that directly operates the cutters and indirectly controls the tracer through the pantograph. The operator consequently rotates this wheel with a smooth, continuous, hand-over-hand motion with his eye on the tracer. A few minutes' trial shows that practice makes the tracing easy and certain.

On the model are eight symmetrical reference spots that are sponsoned out beyond the ship's side and cut to a true plane on the top side as the model floats in the water. Hook gauges are hung in pairs, two forward and two aft, to adjust and determine the draught, and to ensure that the model is not sagged or hogged beyond a trifling amount. The displacement of a model is expected to be correct within one-tenth of one per cent. An attendant thought that three-tenths of a per cent would be a "lot."

Paraffine models are kept immersed to avoid straining when not in use. The temperature of the water at Hasla seldom varies much from 65 degrees, and a low temperature is considered essential for the proper preservation of models. When in use the models are likely to be slightly hogged because the top sides which are exposed to the air are likely to be at a higher temperature than that of the water.

The most interesting feature of model experiments is the investigation of the wake and its effect on the efficiency of propulsion, and this problem is the more difficult because the wake of a model is liable to be ten per cent greater than that of a full-sized ship. There is further complication from the fact that the pitch of the propeller, whether that of the model or that of the ship, is open to doubt even though both are carefully made and measured. However, the wake diagrams are similar though not similarly placed and the comparisons of model experiments and trials of ships correspond as well as the method warrants.

Some of Mr. Froude's more recent work has been on the resistance of ships among waves as described in his paper entitled "Model Experiment in Hollow and Straight Lines." The conclusion of these investigations will be remembered to show that for certain cruisers the best sea speeds will be obtained from ships which show some hollowing of water lines at the bow. This conclusion is notable in that it differs from the conclusion of modern designers that hollow lines are always to be avoided if possible both for steamers and sailing crafts.

The apparatus still in place consisted essentially of a wooden diaphragm having the full width of the canal but only a depth of two feet four inches, and which would be given a motion approximating that of a dynamical vertical of the trachoidal wave. The waves made by this apparatus were most interesting to one who had given attention to the theory of waves. In the first place, the waves showed surface wrinkles or surface tension waves when the apparatus was first started, but these soon disappeared. The most interesting feature was that the waves which were on the point of breaking, had an angle of 120 degrees at the crest, as is indicated by Stokes' theory of irrotational waves. The form of wave profile given by this theory is much more like that of waves on the deep sea than the conventional trochoidal profile. Fortunately, the profiles approach each other as the height diminishes in proportion to the length, and we may use the various conclusions from the familiar theory for the proportions that are treated by naval architects. Again, it was very clear that the velocity of a group of waves was about half that of the individual wave, but this is a familiar phenomenon to any one who has amused himself by dropping stones into a pool.

It is interesting to know that the water in the tank is renewed only sufficiently to make up for evaporation and other losses. When the tank was first filled, a summer's growth of weeds was found to be troublesome; but that growth decreased year by year until it has ceased to be annoying.

All the European stations are modeled on the station at Hasla; and while every facility was most courteously given by those in charge it could not be expected that the work of the station and the time of those in charge should be sacrificed to the casual visitor. Each station had its own individuality which I will try to throw into relief avoiding tedious repetitions or comparisons.

The second experimental model station to be installed was the one at the Leven ship yard, belonging to Messrs. William Denny & Brothers, and its date (1884) preceded that of

the Hasla station by two years which gives it a peculiar interest in that it followed closely the arrangement of the first admiralty tank at Torquay. In particular, the rails for the carriage were suspended from the roof over the tank with only sufficient space between the rails for the convenient handling of the model and the recording apparatus. The carriage is very light so that the longitudinal oscillations of the wire towing rope does not give any trouble with the rope directly connected to the carriage. There appears to be no thought of substituting electric traction, nor does that appear to be convenient.

The possession of this station has enabled the firm to take a leading position in the solution of certain problems in naval architecture such as very high speeds for paddleboats and the installation of steam turbines. It may be interesting to rehearse the first notable means that they owed to towing experiments. In 1888 the firm desired to bid for the construction of a fast paddleboat which was required to have at least 19½ knots speed on a length of 300 ft. and a beam of 35 ft. At first the scientific staff hesitated when the firm expressed a desire to guarantee at least a knot more than the required speed; but after tests on several models it was decided that a speed of 20½ knots could readily be promised, and on trial the ship showed a speed of 21.6 knots. The model selected had a beam of 38 ft., or three more than that specified, which were in direct opposition to the common opinion at the time. In passing, it may be recalled that for paddleboats the location and form of the waves which accompany the boat and come in contact with the hull, together with the location of the wheels with reference to such waves, is of prime impo t-ance, and such question can be intelligently investigated by aid of the experiments on models with comparatively little trouble and expense. It is most remarkable that while most explicit information based on experiments and experience now exists for screw-propeller propulsion of ships, the printed information with regard to paddle wheels is very scanty and unsatisfactory, and requests for information, such as dimensions, revolutions and speeds, are not welcomed by those who have information.

A member of this firm expressed the opinion to the writer that every important yard would do well to have its own tank, and said that even with their large amount of accumulated information they kept the tank busy and would give work to another tank if they had it. How different this is from the common opinion that, if only such a tank could be installed, it might take in work for all the ship builders in the country. At the same time an opinion was expressed favorable to the establishment of an "open" tank not hampered by governmental secrecy or trade jealousy, at which scientific problems could be investigated, such as the best forms and proportions for various speeds and conditions. The need for such work was emphasized to the writer by the fact that he found those in charge of a recently established private station engaged in just such an investigation while it may be fairly assumed that every well-established station has that information filed away for ready reference.

The next station in point of time is that at Spezia, belonging to the Italian government, which has always shown boldness and originality in the development of its navy. As might be expected, it resembles very closely the Hasla station, and still has the car drawn by a cable, though the substitution of electricity is under consideration. An obvious feature was the substitution of brass and steel in place of mahogany, by the instrument maker intrusted with the construction of the apparatus, but good discretion was shown and the changes need not necessarily be open to criticism. This station had the greatest interest to the writer because it, like our Washington station, is liable to have a temperature of 95 degrees Fahr., and yet the models were made of paraffine; they, of course, are immersed when not in use, and tests may not be made during exclusively hot weather. The opinion was expressed by Capt. Bonfiglietti that the main difficulty in the use of paraffine came from the distortion due to unequal expansion of the parts of a model exposed to the air or to water when in use, and that for this reason the models should not be more than 13 ft. long. On the other hand, models as long as 20 ft. are made of paraffine at Berlin, where occasional high temperature is to be expected. The details of the installation of this station, and reports of important investigations, such as the influence of depth of water on speed, are given at length in a large volume published by Col. Rota, of the corps of naval constructors.

They have at this station a carriage for testing two or three propellers at a time in place behind a model, and an arrangement for four propellers is under construction. In the preparation of model propellers, drawings are made at a convenient enlarged scale which are reduced photographically to the required size. A wooden model is then made to these drawings which is used as a mold for casting the composition blades. This method may be contrasted with the method devised by Froude and commonly followed, in which the face of the blade is cut in plaster of paris to a true helical form; the blade is then molded in wax on this surface; then a back is made in plaster, which with the face (after the wax is removed) form the mold for the composition blade. The composition is a readily fusible alloy of tin, lead and bismuth.

Much trouble was experienced from vegetable growth in summer, but that has been obviated by using copper sulphate in the proportion of one to three hundred thousand. Incidentally, this copper salt stained the models an agreeable green tint.

The fourth station to be established, and the second for a private company, was that at Bremerhaven, belonging to the North German Lloyd Steamship Co. This has been used in determining the forms and dimensions of new ships for their fleet. Work has also been done for foreign governments and private firms, both German and foreign. The carriage has a steel frame made of vertical tubes and diagonal ties and appears to be light and rigid. It is driven by two six-H. P. electric motors and was the first so designed.

At Charlottenburg, near the Technishe Hochschule, is a station that is owned in common by that institution and by the German admiralty, the latter having exclusive control for certain months each year. When seen by the writer the station was under admiralty control and was used for the investigation of the action of a ship in a narrow channel with sloping sides like a ship canal. The carriage is constructed of steel angle bars of small section, and appeared to be fairly light and stiff. It is drawn by a separate driving or locomotive car which had two electric motors. A new device was seen for testing four propellers behind a model, which was said to give satisfaction; it was covered with canvass and was not exhibited.

Models are made up to 21 ft. in length of paraffine, and while prolonged hot weather may not be expected, occasional high temperatures are experienced. This is interesting

in comparison with the limitations advised at Hasla and at Spezia. This tank has a peculiarity, which, however, is likely to soon disappear; namely, the width near the water surface is increased by a bench on each side and at the edge of a bench is a row of columns carrying the rail for the carriage. It is proposed to carry the side wall up to the rail, doing away with the bench. It is reported that though the rail appeared by calculation to be stiff enough, these isolated hard spots give a jar to the carriage that appreciably affects the recording apparatus.

The last station to be seen was appropriately the last installed. This was at the yard of John Brown & Co. on the Clyde. It is a very close copy of the station at Hasla, closer, in fact, than any other seen, except that it has electric traction; and consequently presents fewer peculiar features. Important work has already been done though the station has been in use less than two years. A considerable amount of attention has necessarily been given to building up a stock of information, and that work is not yet complete. True that information exists, but it is locked up in the archives of government bureaus or the files of private drawing offices.

The writer was informed while in Paris that a station was in process of development for the French navy and has learned that it is now open for work. It follows closely the Hasla prototype and in fact was furnished with apparatus by the makers who have supplied other European stations. The writer's credentials, unfortunately, did not include introduction to this station and the individual peculiarities cannot, therefore, be reported.

EXPERIMENTAL MODEL STATIONS.

Date.	Location.	Length.	Breadth.	Draught.
1884	Leven ship yard Dumbarton ..	300	20.	8.8
1886	Harlan	400	20.	9.2
1889	Spezia	479	19.7	9.8
1900	North German Lloyd S. S. Co., Bremerhaven .	538	19.7	10.
1903	Charlottenburg .	528	34.5	11.5
1904	John Brown & Co., Clydebank	490	32.	10.

DISCUSSION.

Prof. Sadler, in the course of reading his paper said: This tank perhaps differs from others mentioned in the previous paper, in this respect, that it was not designed primarily as an experimental tank alone. It was part of the new engineering building, and as I pointed out to the board of regents, we had practically the tank already completed when we had the foundation wall on the one side and the heavy wall on the other for carrying the roof; it simply meant a little more excavation and we would have an experimental tank. We appealed to them and we got the tank in that way, and we had to conform to the general of the design of building, rather than to the experimental tank alone. Hence, the necessity for some of the peculiarities, such as carrying the truck on brackets; also carrying the motor generator set on the truck itself.

Mr. D. W. Taylor—Mr. President, I am glad to see two valuable tank papers laid before us this time, giving so much valuable information on the subject. I may say that last summer I had the opportunity myself of visiting three of the stations that were visited by Prof. Peabody, namely, the Hasla station, the Denny & Bros.' tank, and the John Brown & Co. tank on the Clyde. Two of them I visited many years before, but the John Brown tank, which was the latest, I had never seen before. As will be found by any one who compares the description of these tanks with the description of the model basin at Washington, which was published in the *Transactions* for 1900, it will be seen that the one in Washington differs radically from the foreign stations. The principal reason for that is the fact that the models which we use are made of wood instead of being cast in paraffine, as described by Prof. Peabody. As will be found by reference to the 1900 paper, we found by overwhelming experiment that any paraffine we could get would probably give us a good deal of trouble with the summer temperatures in Washington, and that is confirmed by Prof. Peabody's paper where he says that at Hasla the average temperature seldom rises above 65°, in the water. In Washington we could not keep the temperatures down to anything approaching that, and at the time we made the experiments we came to the conclusion that above 75° the paraffine we could get would be, instead of a solid, a liquid which would change its shape slowly, but persistently change its shape. That seems to be confirmed by the fact that even where the temperature is low it is necessary to keep the paraffine models immersed in the water; if exposed to the air they change shape. The Berlin tank seems to be an exception, and although they have fairly high temperature now and then in the summer, the average temperature must be very much lower than the Washington temperature. Berlin is many degrees further north than Washington, probably 15 at least.

Prof. Peabody in his paper says: "An advantage of a light carriage as is found in all European stations is the fact that the rails, which are truly well laid and occasionally inspected, do not show evidence of any extraordinary care, such as grinding, to reduce minute roughness." I found that in one of these tanks they considered it necessary to give extraordinary care, as they had a great deal of difficulty, owing to the fact that the rails did have minute roughnesses, and they were anxious to know how we avoided the troubles which they had experienced. I should say further, with reference to the question of paraffine models, that another reason for adopting the wood was the fact that we wished to make the models fairly large; having every confidence in the law of comparison, we did not feel desirous of stretching it too far. A 12 ft. model has only about one-fifth the displacement of a 20 ft. model, and by making the model with five times the displacement, we thought we would have a model in whose results we could feel more confidence. The quantities to be measured are small in every case, even in the case of a 20 ft. model. The resistances of the model at corresponding speed is frequently under 10 lbs., and the model perhaps weighing 2,000 lbs. If we have to measure a resistance which is less than a fifth of that, less than 2,000 lbs., accidental errors are exaggerated. It is impracticable, at least we thought it was, to make 20 ft. models of paraffine with any confidence, as it is not a good material to handle.

There is another point in this connection, the universal practice in foreign tanks, and largely in our own, has been to test the models without appendages. That is a very convenient and a very reliable way of getting at the best model, but it does not give you the actual resistance of the ship as she is tried. These appendages offer more resistance than is generally supposed or realized; take the case of a man-of-war, which has more appendages than a merchant ship. For such a vessel, with bilge keels the appendage resistance is seldom less than 10 per cent of that of the bare hull; with bilge keel and double struts, perhaps double docking keels, the total resistance may amount to 15 per cent or more, and that is a matter which requires careful investiga-

tion and consideration. There is also a good deal of difficulty in applying appendages to paraffine models, many of them, not so much in doing the work, if you can keep the models cool, but it is more convenient to take the models out of the shop and cut out the appendages and put them on at a more convenient time. We have preserved at the Washington model basin probably 150 models, and have preserved the models which are likely to be of permanent value, the models of actual ships; and we have several times found it desirable to retain these models—some question arises about the ship which can only be tested by running the model. We cannot foresee at the time we get out a model everything which has to be tested. There is one great advantage, two advantages, of the paraffine; one advantage is the cheapness of the paraffine and the other advantage is the fact that you can get a very good surface with much less labor. The surface with the paraffine is constant, and to obtain a constant surface we have to be very careful in shaping the wood. I note on page 7 that Prof. Peabody states, with reference to the station of the North German Lloyd Steamship Co., at Bremerhaven, that the carriage has a steel frame made of vertical tubes and diagonal ties, appears to be light and rigid, and is driven by two 6 H. P. electric motors and was the first so designed. He gives the date of the tank as 1900. I asked him the date of the design.

Prof. Peabody—I cannot be sure of that. I am open to correction, Mr. Taylor, with regard to the question as to the place at which electric traction was first used in connection with tanks. That information was given to me at the station.

Mr. Taylor—I do not know the date of the North German Lloyd tank, but it is given here as of 1900. The tank in Washington was in operation in 1899 and designed in 1897. I was under the impression that we were the first in the field. I should like to get the exact date of the design, merely as a matter of record, because certainly as regards operation we were in operation in 1899 and the design was two years ahead of that. Owing to the Spanish war we were delayed a good deal in getting the tank into operation.

On page 4, in reference to Mr. Froude's experiments, the statement was made with reference to these very interesting experiments: "The conclusion of these investigations will be remembered, to show that for certain cruisers the best sea speeds will be obtained from ships which show some hollowing of water-lines at the bow. This conclusion is notable in that it differs from the conclusion of modern designs that hollow lines are always to be avoided if possible, both for steamers and sailing crafts." That conclusion of Mr. Froude applied only to certain speeds. As regards hollow lines and straight lines, I do not propose to enter too much into that controversy, but I should say in our experience, which agrees with Mr. Froude's, I believe that at certain speeds it is desirable to have hollow lines for smooth water work. You gain a distinct advantage. In most cases at the speed in knots, about equal to the square root of the length of the ship in feet, the hollow lines appear to show the best advantage, that is the speed above the ordinary speed of vessels. When you come to high speeds, such as torpedo boats, the hollow lines have a disadvantage, and it would be necessary to have the straight line, or even a rounding line. There is one other matter with reference to Prof. Peabody's paper, where at the bottom of page 5 he says: "In passing, it may be recalled that for paddle boats the location and form of the waves which accompany the boats and come in contact with the hull, together with the location of the wheels with reference to such waves, is of prime importance." In that connection I might point out that paddle boats frequently have to operate in shallow water, and care should be taken in locating the wheels of the paddle boat, even for a model experiment, in deep water. In shallow water the wave lengthens; the crest which in deep water may be forward of amidships, the shallower the water the further aft the crest moves; in other words, the longer the wave gets. I have known of a case where there was some difficulty on that account. I sympathize very much with Prof. Peabody in his remarks on page 6, where he quotes: "At the same time an opinion was expressed favorable to the establishment of an open 'tank' not hampered by governmental secrecy or trade jealousy, at which scientific problems could be investigated, such as the best forms and proportions for various speeds and conditions." I may say I found one of those tanks, which I visited this summer, had just finished a series of experiment, and practically duplicated a lot of work we had been doing and just completed. As regards the tank in Washington, many of the results are necessarily not made public, and the results of tests for private persons which under the law are made, are required to be kept private and not divulged without the consent of the person for whom the tests were made. The position of the chief constructor, both the late chief constructor and the present chief constructor, has always been that there was no objection, but every encouragement should be given, to the publishing of results of general scientific value. We have taken the attitude, not only in the way of publication, but in the way of telling people who come to visit the tanks, that we have very few secrets.

Mr. F. B. King—Is there time available outside of the government use of the tank for private experiments?

Mr. Taylor—As regards Mr. King's question, I will say that we have made a number of experiments of general scientific value, and we have published the results of some of them; a number of them as regards propellers, but we have published a very few as regards hulls, because these experiments have not been entirely completed. That has been done in the interval of more pressing work for the determination of problems connected with the actual design of men-of-war, the results of which we do not publish. We have accumulated a mass of data, and probably in the near future more of it will be published than has been published in the past.

With regard to the new French type, I gather from the press that this was established last spring, put in operation and about a month later the statement was made they were having a great deal of trouble with the paraffine models. The temperature in Paris rises pretty high at times, and last summer was an unusually warm summer abroad. Even in London they had temperatures higher than they have had for many years. There is one thing in Prof. Sadler's paper which I was pleased to see. In giving the results of his experiments, the two curves on the last page, he plots the results in resistance in pounds per ton of displacement. I believe that for the purpose of analysis that is distinctly the best method of plotting results. It eliminates the question of dimensions, that is, the resistance divided by the displacement, as a non-demonstrable quantity, and you are at once able to apply the law of comparison to these results and I believe it is much the most instructive and profitable method of plotting.

(Vice President McFarland in the chair.)

Vice President—Has any other gentleman anything to say on these interesting papers? Mr. Dickie, have you any comments to make?

Mr. Dickie—I have nothing to say at the present time.

Mr. F. B. King—It seems to me it would be very desirable if any of these gentlemen could give us some data in regard to the cost of these tanks. I suppose such matters are kept rather close, but if the information is only approximate, I do not doubt it would be very useful to ship builders, that is the larger ship builders who have in contemplation the establishment of such a tank. In regard to the policy of establishing such a tank for a large private ship yard, Mr. Peabody gives us the attitude of Mr. Denny, a member of the firm of William Denny & Bros., in regard to that matter, where he says: "A member of this firm expressed the opinion to the writer that every important yard would do well to have its own tank, and said that even with their large amount of accumulated information they kept the tank busy and would give work to another tank if they had it." In regard to that, I would say that I have been in the Denny ship yards on two occasions, and about two weeks ago I had a talk with one of the younger Denny brothers, in regard to this matter, and he said he thought that isolated model experiments gave very little useful information, and they were apt to be failures, and he thought it was much better on that account for any concern to biuld up its own data. It appears in a series of model experiments, we have very much the situation of a lot of crabs in a basket, that every crab in the basket takes hold of every other crab, and model experiments made with other or similar models. One other point in Prof. Peabody's paper I want to refer to, although it is somewhat unimportant. He says that in the tank at Hasla the displacement of model is expected to be correct with 1-10 of one per cent, and at any rate within 3-10 of one per cent. That involves almost a microscopical determination of the draft, and I think perhaps Prof. Peabody can give us some information as to how that is determined so exactly. Even the marks on the model would be fallacious, because capilliarity alone would throw us entirely off, if we aimed at such an exact amount of precision. I see no reason for aiming at such exact precision with regard to the draft.

The Vice President—We would be glad to hear from any gentleman if he has any questions to ask or additional information to give.

Mr. C. C. Thomas—Mr. Taylor, do you care to say how the draft is determined for its accuracy, or whether it is a usual thing to get the displacement in such an extremely minute way?

Mr. D. W. Taylor—That is a matter I inquired into in the case of the Hasla tank and the other tank. As a matter of fact they do not know what they get, because they do not measure the material after they cut it. With the hook cages they place the model at a certain draft, but do not know what the shape of the model is below the draft, as they do not measure the material after they cut it. Any statement as to the fraction which it amounts to is largely guess work, in addition to the fact that a paraffine model more or less changes shape. It is our practice to measure every model after it is cut, and after we measure the model we work from the model itself rather than from the original design alone. We find calculating the displacement of the model from the measured dimensions of the model, that the displacement to a given water line agrees, as a rule, within probably ½ of one per cent. If it goes to as much as one per cent out, we look for trouble. Frequently we have them come exact, that is on a 2,000 lb. model, within four or five lbs. We do not run the model by its draft. The model is weighed and the amount of ballast necessary to put it down to the desired displacement is determined, and the model is run at the displacement rather than the draft. We have draft marks on and use them as a rough check. Since the law of comparison involves displacement primarily, rather than draft, if we run the model at the correct displacement, even if there are slight deviations from the original design, so that the model at the correct displacement is a shade above or below the designed waterline, it makes very little difference.

Mr. King—Has the matter of capillarity ever been taken into account in regard to the draft or displacement of these models? With your large models, you would probably reduce that source of error very much, but I think in a small model that question really appears to be of considerable importance.

Mr. Taylor—That is the object, as I understand, of the hoop gauges used to take the draft. If you take the draft without knowing they stick down into the water, you have trouble with capillarity. These hoop gauges just touch the water and you can get the draft with much regularity by the hoop gauge, and get the draft in a most accurate manner. The draft is a prominent determination of the model. We run the model at a given displacement which we determine exactly by weighing.

The Vice President—Do either of the authors of the papers wish to make any closing remarks?

Prof. C. H. Peabody—I am quite gratified to hear some discussion on this paper, because I had more than a doubt as to the desirablity of presenting it. It has, however, elicited an amount of information which would be worth while if we got nothing more from it. I distinctly disclaimed any comparison with our Washington tank, because I intended to do no other thing than give information, and we have the whole information given us in the paper already presented, except with important additions which have been given us now by Naval Constructor Taylor. There are a few things I wish to say, not so much that I think the statements need answering, but to make my position clear. I wish that the question of the temperature had also been discussed by our chief technical adviser to our navy, because that was the most interesting feature that I found, that they were actually using paraffine models there. I have myself seen a paraffine model, without any other material, fall over on account of the hot weather, and had not supposed paraffine would be reliable at even moderate temperatures. The statement regarding several things, such as grinding the tracks, came, of course, on inquiry and the statement that some attention had been given to this subject is of course additional information. As for Mr. Froude's experiments, in regard to hollow lines, it is stated only in a general manner, with a limitation which, of course, we found was in its favor. I think I will withdraw the statement of the time of electrical traction at the Bremerhaven station, and possibly when the review of the discussion comes up that question may be withdrawn. Mr. Taylor has clearly pointed out how the gauge may be used, and I can say, from my own experiments with the gauge, that the draft can be obtained with extraordinary accuracy in that fashion; within a thousandth of an inch. I would like to remark with regard to Prof. Sadler's paper that coming from a technical school,

where the question of an experimental tank has frequently been discussed before our authorities without avail, the only thing I can say is I wish I could find some excuse which would induce our authorities to consider—it would not cost very much—putting in a tank. A remark was made by one of the authorities at one of the English technical schools, that certain features of our schools made them green with envy. I say that these things which you have had described about the school in Michigan has certainly made me green with envy; this particular feature. We find in the University of Michigan that they have certainly an experimental station of which they should be proud.

The Vice President—We would be pleased to hear from Prof. Sadler on his paper.

Prof. H. C. Sadler—In connection with the use of paraffine, one of the main reasons why we adopted it in the University of Michigan tank was on account of its cheapness. Unfortunately, we have not all the money we should like to spend on this work, and we have had to use the cheapest material we could get; wood was almost out of the question. With regard to the change of shape, I tried some experiments on that line, and I left some models floating in the water, ballasted, for several weeks. At the end of the time—I forget the exact time now—the models had sagged about 1/8 in. at each end, 8' models. They did not appear to sag very much more after that, as far as I could judge. Before deciding to use paraffine, I may say that I wrote over to Mr. Froude, and he advised me that as the result of his experience you could keep the paraffine in a temperature below 75°; if you could keep it in such a temperature you would not have much difficulty with it, but that above that temperature models would be very liable to change shape. Some one asked the cost of such an installation as this. I am sorry to say that is almost impossible to determine. As you see by the plans, the tank itself is a part of the buildings, that is, the foundation walls had to go in in any case, and a certain amount of excavation had to be done, and we have as it were, had the ground floor put in just ten feet lower down, so that it is a little difficult to say how much that really added to the cost of the building, what we should charge as the cost of the experimental tank itself. Most of the apparatus having been built in the university shops the question of determining the cost of the tank is quite difficult. We always very carefully measure our models before experimenting with them, for the reasons that Mr. Taylor has given, although our cutting machine, as far as we can judge from test afterwards, cuts very accurately to the line, yet there may be little errors, especially in flaring up, and it is well to have an accurate record of the model rather than an imaginary record, one taken from the drawing. We have under way at present a series of experiments on the longitudinal distribution of displacement, which I hope to have finished by next year, and to present to the society at that time. I am sure we shall be gratified at any time to carry out any experiments that any members may be desirous of having us do.

MANCHURIA AND MONGOLIA.

The Pacific Mail Steamship Co.'s giant liner Manchuria on her return to San Francisco in a badly disabled condition, was placed for a few days in the Hunter's Point dry dock to undergo mere temporary repairs. She is very soon to be again placed in the same dock to undergo a complete overhauling before going into active service. She has been carefully surveyed by the board of marine surveyors, and it is estimated that the actual cost of the repairs will be very heavy. It will be at least four months and a half before the Manchuria will be able to again go into active commission. The Union Iron Works are bidders for the repairs, and it is more than likely that that corporation will be awarded the contract. As yet the specifications for the repair work have not been completed. Her forward hull was found to be in a very bad condition from grounding on the rocks, the plates being battered and bent and perforated in a number of places. Most of these damaged plates will have to be replaced with new ones.

The sister ship, Mongolia, has just come out of the dry dock where she has been for the past ten days undergoing a temporary overhauling. The serious damages to the Mongolia have been just merely patched up—though in a substantial way. She will sail for the Orient in about a week with freight and passengers. Later, this huge liner will be thoroughly repaired the same as the Manchuria.

An examination of the hull of the Mongolia showed that the heavy plates forward were crushed, ground and perforated in both the outer and inner bottoms, and water poured into holds Nos. 1 and 2. The damages are on both sides of the keel. Heavy dents are found along the plates in various places, though there were no gaping rents. Yet the water found easy access into the hull.

As in the case of the Manchuria, the damages to the Mongolia will cost a large sum.

AN OFFICIAL DEADLOCK.

There is an official "deadlock" between United States local inspectors of hulls and boilers, Bolles and Bulger, of San Francisco, Cal., over the question is to blame for the grounding of the P. M. S. S. Co.'s vessel, Mongolia, on the coral reef at Midway island. Inspector Bolles wanted to censure Capt. Porter, of the Mongolia, for the accident, and Inspector Bulger blamed First Officer Martin for failing to report the soundings promptly. When Bolles submitted his written decision to Bulger, the latter refused to concur. As these officials could not agree as to which officer was responsible for the disaster, after a long conference, the two adverse decisions were handed up to United States Supervising Inspector John Bermingham, who will later have to decide the case himself. There was a great deal of conflicting testimony at the trial of Capt. Porter before the inspectors.

The largest cargo of lumber to reach the Tonawandas was taken there recently by the steamer John F. Eddy of the Tonawanda Iron & Steel Co.'s fleet. The Eddy's cargo consisted of a trifle over 1,800,000 ft. of lumber. In order to get this cargo out of the hold of the Eddy, Herman Licht, foreman of the lumber gang, said that it would require four handlings, owing to the depth of the vessel. The Eddy is not a lumber carrier, being usually employed in the ore trade. The largest cargo taken to Tonawanda previous to this was 1,450,000 ft. on the lumber steamer Fred A. Meyers.

Mr. Charles E. Eales of the Hildreth Varnish Co., 32 Broadway, New York, is in the great lakes district on behalf of his company. The paint which he is seeking to introduce is made after Moores' formula, which was quite extensively described in the MARINE REVIEW some years ago. It has great adaptability to iron and steel and when used as a primer renders unnecessary more than one coat of paint for many years thereafter.

The Canadian Pacific elevator D at Fort William caught fire last week and was totally destroyed. The loss is estimated at $350,000.

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NORTHERN PACIFIC BRIDGE AT DULUTH.

For several years past the Lake Carriers' Association has consistently followed the policy of urging, whenever practical, the substitution of lift, or bascule bridges in place of swing bridges across navigable streams. At the annual meeting of the Lake Carriers' Association held at Detroit, in January, 1902, the following resolution was adopted upon this subject:

> As the art of bridge building is now sufficiently advanced to render unnecessary the building of artificial obstructions in the centers of navigable channels, this association respectfully requests the secretary of war to direct engineers of his department to withhold approval of center pier swing bridges in such channels and substitute therefor, when it is practical to do so, and when the same can be done at no greater cost, some one of the several types of vertically lifting bascule bridges which are successfully used in several lake cities, especially the crowded harbor of Chicago.

It would appear as though no argument were necessary to demonstrate the superiority of a lift bridge across a navigable stream over any type of bridge involving center piers or projecting abutments. Attention is now directed to this subject by the vessel owners, owing to the designs for rebuilding the Northern Pacific bridge at Duluth. This is the railroad bridge between Duluth and Superior across the inner bay. At present the bridge consists of two draws spanning the two channels, one on each side of the river and connected by a long trestle across the shallow middle part of the basin. The draws at present are 100 ft. wide, and according to plans which have been approved by the government engineers' department, the new draws are to be only 125 ft. wide. On Oct. 19 vigorous protest against these plans were made by the vessel owners. It is now understood that the Northern Pacific Railway is agreeable to the building of a lift bridge, but this, of course, involves a modification of plans already approved by the war department. The situation has also been somewhat complicated by the recent transfer of government engineers at Duluth. Major Graham D. Fitch succeeding Major Charles L. Potter, who has been transferred to Long Island. Major Fitch is probably unacquainted with the long campaign that vessel interests have made to substitute a lift bridge for a swing bridge whenever any of the old swing bridges were to be rebuilt or replaced. Major Fitch is inclined to insist that the railroad company build two swing bridges. If the railroad company is willing to substitute a lift bridge for the present swing bridges there is no sound reason why they should not be permitted to do so. The rights of navigation are paramount, and, all things being equal, vessel owners should certainly have a preference as to the type of structure to be thrown across any navigable stream. The policy at Cleveland, Chicago and Buffalo has been to substitute lift bridges for swing bridges whenever practicable. Sixteen have already been removed at Chicago and seven at Cleveland and replaced by Scherzer rolling lift bridges. Instances could be multiplied of the serious impediment to navigation by the old type of swing bridge. Two such accidents have occurred on the great lakes this year, one the wrecking of the interstate swing bridge at Duluth, which inconvenienced the movement of vessels for many days, and the other the wrecking of the new center pier swing bridge at Houghton, Mich. Neither of these accidents could have happened with a lift bridge. The situation at Duluth is quite important, and it is not likely that vessel owners will permit the present plans of the war department to be carried out without a stubborn fight.

DULUTH-SUPERIOR HARBOR.

The general purport of the recommendation of the board of engineers appointed to investigate conditions at the Duluth-Superior harbor, with a view to providing such improvements as seemed wise, has been made public. As will be recollected, their investigation included a thorough examination, by the board, of the harbor and its present equipment, as well as a hearing of all the interests concerned in the matters effected by conditions at the head of the lakes. At the time of the investigation, two general plans were urged upon the engineers, one for the construction of a breakwater extending out from the north shore of the lake for nearly a mile, to protect the Duluth entrance; the other for the cutting of a new and much wider canal through Minnesota Point, opposite the entrance to St. Louis bay, with such other protection as that opening would require. No suggestions of any importance were offered regarding changes at the Superior entry, all of the undesirable conditions being felt at the Duluth end of the bay.

Th engineers' report provides for but little change in the present plans for the Duluth entrance, some $10,000 being the total appropriation, and it does not consider at all the opening up of a central canal. It provides, however, for the expenditure of approximately $1,800,000 for the building of a V-shaped breakwater at the Superior entry. This breakwater will be a mammoth structure with Wisconsin Point as the base for one leg of the V, and Minnesota Point for the other, each leg to be 1,000 ft. in length. They will converge at a point opposite Superior entry, with

an entrance amply wide to insure the safe passage of vessels in the most severe storm. It is believed that this form of outer entry will result in the dissipation of the waves, largely before reaching the inner entry, which will be made wider than at present, and at any rate, by the time of reaching the inner harbor. In addition to this, the channel will be widened and deepened in the outer harbor to 30 ft., and through the natural entry to a uniform depth of 24 ft. The interior basin will be deepened, and the navigable area increased, affording much greater freedom in the movement of boats from Superior entry to the entrance of the river.

While at first glance it may seem that neither of the interests at Duluth had been served in the recommendations of the board, there is much in the improvements suggested which provides for all the difficulties which each has felt existed. In the first place, improvements to be made have been adapted to the natural advantages of the harbor, and to the artificial improvements already existing. Disadvantages admittedly exist at the Duluth entrance, but even with the improvements suggested for it there was still much room for doubt as to the betterment of conditions. With no improvement planned for the Duluth entrance, conditions will not be worse, and no money will have been spent uselessly. In regard to the central canal, it may be pointed out that there were decided disadvantages to many property owners attendant upon the carrying out of that plan. The harbor conditions that would have existed with the central canal were also a matter of conjecture, and, according to the recommendation of the board of engineers, one of the great advantages which the adherents of the central canal earnestly sought, a wider entrance, is to be provided at the Superior entry.

With the harbor improved as now proposed some remedies may be devised for the Duluth entrance much less costly, and devoted entirely to the prevention of existing conditions at the Duluth entrance without the necessity of taking into consideration also the danger of entry for boats under stress of weather, for the arrangement of the Superior entry is intended to provide a harbor which in time of particularly heavy weather may be used exclusively by all boats, for both Duluth and Superior. It would seem, therefore, that the board of engineers had provided an extremely wise compromise between the divergent ideas, as well as a plan for maximum improvement at minimum cost, with a full utilization of the natural advantages of the harbor.

LAUNCH OF MIDLAND PRINCE.

The fast-growing marine of Canada received a splendid addition last week when the new steamer, the Midland Prince, built to the order of the Midland Navigation Co., was launched at the yards of the Collingwood Ship Building Co. The event was witnessed by thousands of the people of Collingwood, also by many from outside points. Included in the outsiders was a party of thirty or forty from Montreal, composed of Mr. Charles M. Hays, general manager of the Grand Trunk railway, and friends, and upwards of a hundred of the citizens of Midland, the home port of the new steamer. Special trains from Montreal, Toronto and Midland were run.

The vessel was launched into the company dock, on the eastern bank of which it was built. Miss Hays, daughter of Mr. C. M. Hayes, christened the new steamer.

The Midland Prince is 486 ft. over all and will carry about 8,000 tons on 20-ft. draught. She was built for the Midland Navigation Co. (James Playfair, once president), and is intended for the grain trade and general lake freights from Port Arthur, Fort William, Duluth and Chicago to Georgian Bay ports and Lake Erie ports. She being much too large to pass the Welland canal, is built exclusively for the upper lake trade, and is of the highest classification, 100 A. 1 register, and with the most powerful and highest class of engines and boilers, all of which have been constructed at the works of the Collingwood Ship Building Co. There are two Scotch boilers, 15½ ft. diameter and 12 ft. long, between heads, and triple expansion engines 23 in. 38½ diameter by 63 in. cylinder, 42 in. stroke, 2,200 I. H. P. She is equipped with all the modern outfit of decks, winches and steam-mooring gear, also built at the shops of the Collingwood Shipbuilding Co. Her outfit throughout is the best that can be made, and all round she is a most complete ship to handle and carry cargo safely and cheaply.

After the launch a banquet was held in the spacious drafting hall of the ship building company. Covers were laid for 260 people, and every seat was occupied. Mr. Arthur Hill, Saginaw, Mich., president of the Navigation Co., occupied the chair. After the royal toast was honored, the toast, "Rail, Lake and Ocean," was responded to as follows: Mr. C. M. Hays, "Railways;" Mr. Gear, Montreal, "Ocean;" and Mr. Cuttle, Montreal, "Lake." For the "Grain Trade," Mr. Tilley, Montreal, spoke. The toast to "Ship Building" was responded to by Capt. Alex. MacDougall, Capt. Crandle, and Mr. J. M. Smith, of the Collingwood Ship Building Co. The "Midland Navigation Co." was honored by a toast proposed by Capt. Coles and Capt. Donnelly, and replied to by Mr. D. L. White, Midland. Messrs. Peter Paton and W P. Bull spoke for the "Ladies."

Among those present from outside points were the following:

Toronto.—Mr. and Mrs. J. S. Playfair, Mr. and Mrs. S. C. Beatty, Miss Waldie, Mrs. John Campbell, Miss Alexander, Mr. Frank Hodgins, K. C.; Mrs. Bayne Coulthard, Misses Coulthard, Miss Livingstone, Mr. Joseph Kilgour, Miss Blaikie, Mr. Angstrom, Captain Crangle, Mr. Fred Waldie, Mr. W. B. McMurrich, K. C.; Miss Featherstone, Messrs James Matthews, John J. Main, J. H. Hamilton, W. P. Bull, Robert Inglis, D. Ryan, J. B. Kilgour, H. F. Chaffe, Stuart B. Playfair, McKenzie, McKechnie, and S. H. Thompson.

Montreal.—Mr. and Mrs. Charles M. Hays, the Misses Hays, Mr. and Mrs. A. F. Riddle, Colonel Buchanan, C. M. G., A. D. C.; Mr. George Caverhill, Mr. W. Morrice, Miss Morrice, Miss Arnton, Mrs. A. McFarlane, Colonel G. R. and Mrs. Starke, Messrs. L. A. Tilley, Cuttle, Gear, H. Sims, and James Elmsley.

Midland.—Mr. and Mrs. James Playfair, Mr. and Mrs. N. L. Playfair, Mr. and Mrs. D. L. White, Mr. and Mrs. W. E. Preston, Captain and Mrs. Featherstonhaugh and Mr. D. S. Storey.

From other points.—Mr. and Mrs. Arthur Hill, Miss Grant, Saginaw, Mich.; Miss Coates, Ottawa; Messrs. J. Tudhope and J. Lavallee, Orillia; Mr. W. F. Wasley, Gravenhurst.

A beautiful hammered silver tea service was presented to Miss Hays by the Midland Navigation Co.

The steamer Ionic of the Northern Navigation Co.'s fleet stranded at White Fish Point while enroute from Sarnia to Fort William with a cargo of general freight. The steamer went on a sand bottom and is not much injured.

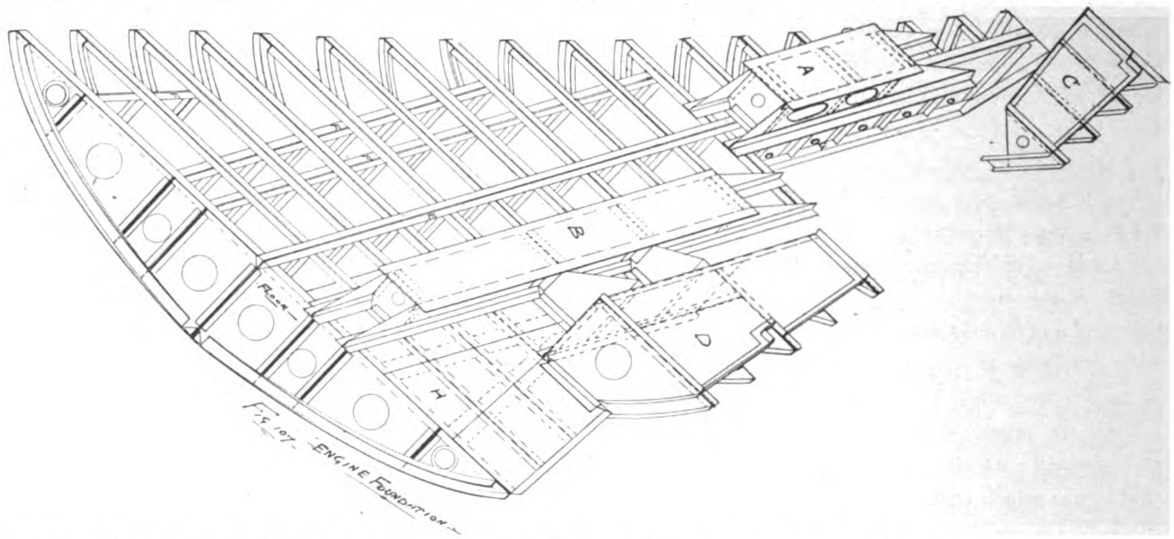
LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

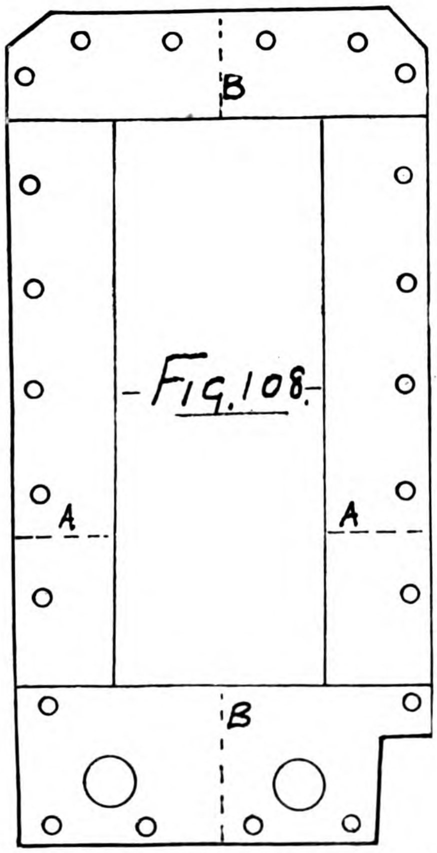
ENGINE FOUNDATION.

Fig. 107 shows the arrangement of stiffening under the engines also the seatings.

The floor plates are made solid and lightened with holes which serve the purpose of man holes, being made large enough for a man to go through. The girders are intercostal and lightened with man holes so that from the center keelson to the bilge is accessible throughout the engine space. A shows the thrust stool which is laid down on the mold loft floor and molds made for same. One mold serves for two side plates, one mold for all division plates and a mold for top plate. A batten with a six-diameter pitch of rivets will do for all the fore and aft angles and for the angles at divisions a mold of tee shape similar to Fig. 24 will do for all these clips.



B shows the bearer for bed plate and one is built on each side of the vessel so that for the fore and aft side plates one mold will do for four plates, two top plates are obtained from one mold and eight division plates. All the other pieces are obtained similar to the thrust stool. C shows the seat for the main feed pump, and is on one side of the vessel only. A mold is made for each piece, which is composed of four brackets, top plate and solid frame. D shows the ballast pump seat and is built on each side of the vessel.

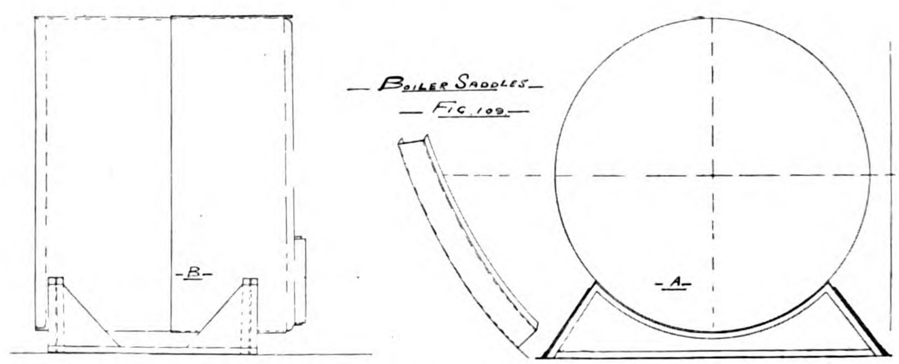


For the ballast pump seat a mold is made for each piece for one side of the vessel and two pieces are marked from same.

E shows the center keelson which is laid out with strips similar to the other parts of the center keelson, only the riveting is all the same with a six-diameter pitch on both sides through keelson plate, engine seat plate and keel. One batten will serve the purpose of marking all the angles and a tee mold similar to Fig. 9 will do for all the center keelson vertical angles. F shows the intercosals fitted between the floors. A mold is made for every intercosal on one side of the vessel, Fig. 108, two plates are marked from same. For the lightening holes a line is scratched in on the mold as shown by AA and BB, Fig. 108, representing center of same. The vertical angles are marked from tee mold similar to Fig. 9. G shows the bottom after end of the center keelson with the floors and frames removed.

The center keelson is not water-tight so that limber holes are punched above the bottom angles as shown by G.

Engine floor plates are laid out similar to the belt frames in the bottom. A mold is made for one side of the vessel and two plates marked from same.



Floor angles or reverse bars are laid off with a batten with a six-diameter pitch of rivets through the floor and on the top the rivet holes are arranged to suit the width of plates and angles for seats.

The frames in the bottom are usually six-inch channels and are marked after being set and beveled with the floor mold. H shows the plating on

top of floor plates which forms the floor of the engine room.

This plating is flanged to the ship's side and is made watertight.

The frames are cut at the side and run in one piece from the engine room plating to the spar deck.

The frames are bracketed to the plating which are laid off in the mold loft along with the frames and engine top plating. A mold is made for each side of the vessel for the plating similarly to all the other work after leaving the midship part of the vessel.

Fig. 109 shows the boiler saddles, A shows a section looking fore and aft and B a view across ships.

Molds are made as shown by plans and all the pieces gotten out and riveted in place before the boilers are shipped.

In Scotland the frames, floor plates and reverse angles would be put together and riveted before being put in the vessel, after which they would be bolted to the center keelson and faired up with rib bands as explained in a previous article. All the parts outside of the center keelson and frames, floors and reverse bars would be lifted from the vessel.

The boiler saddles would be laid off from the mold loft floor but the top angles would not be put on until boilers were in place.

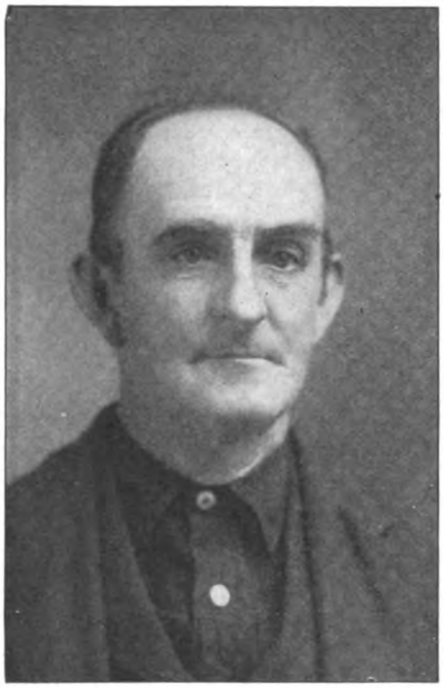
It would cost $600 to mark, punch and erect the engine room work and boiler saddles as per plans, Figs. 107 to 109, in Scotland-on-the-Lakes, this work as shown would cost only half of that amount.

THE PRESIDENT NEARING COMPLETION.

C. D. Dunann, general passenger agent of the Pacific Coast Steamship Co., is authority for the statement that by April 1 the company's first new vessel, the President, which is to ply between San Francisco and Seattle, will arrive at the former port from the east. The President will be the finest steamship in the northern coast trade. She is modern in every respect and will cost more than $1,000,000. The vessel is 414 ft. long, and has a tonnage of 6,000. The President will be followed two months later by the Governor, a second steamer and six months after by a third vessel that has not yet been named. So rapid and steady has the San Francisco-Seattle traffic grown, that the new steamers are absolutely necessary to handle passengers and freight.

JOHN THAYER.

John Thayer, whose portrait accompanies, is one of few Ashtabula residents who has seen that port work its way from a way-port in the old passenger boat days to the greatest ore-receiving port in the world. He has been on hand to witness the marvelous changes made at Ashtabula and a most remarkable memory enables him to recall in detail many important features of the port's early history. In fact, it may be truthfully stated that there is nothing which has happened



JOHN THAYER.

since the '60's he does not remember. Mr. Thayer is a son of Calvin G. Thayer, and a nephew of Capt. Geo. Thayer, both closely identified with Ashtabula's early struggles. He has been sailor, fisherman and bridge-tender, tending the old pontoon bridge for several years. Mr. Thayer lives in the old homestead on "Thayer's Hill."

SHIPPING OF THE WORLD.

A British Board of Trade return on the progress of merchant shipping shows that last year the foreign trade tonnage of the United Kingdom entered and cleared at all ports was 112,040,734, of which 70,963,087 was British and 41,077,647 foreign. Of the total 106,383,971 was steam tonnage, divided into 69,629,360 British and 36,754,611 foreign, the British proportion of all tonnage being 63.3 and of steam tonnage 65.5. In 1850, when the total was 9,500,000 tons British and 5,000,000 foreign, our proportion was 65.1 per cent; but in 1890, with totals of 54,000,000 and 20,000,000 respectively, we had 72.7 per cent and foreigners 27.3 per cent; while in 1900 it was 63.7 and 36.3 per cent respectively, practically the same as last year. In five years the foreign tonnage has risen from 35,812,857 to 41,077,647, while the British has increased from 62,710,836 to 70,963,087.

The returns of vessels "with cargoes only" give Britain a better percentage, the total being 60,757,334 (or 67.8 per cent) against 28,862,515 foreign, and for steamers entered or cleared with cargo the figures are 59,616,502 British (70 per cent) and 25,506,901 foreign (30 per cent).

Taking the first set of figures, or total ships entered and cleared with or without cargo, Germany shows the greatest advance, her share having increased from a little over 3,000,000 tons in 1880 to 6,000,000 in 1900, and 8,645,053 tons last year. Norway, with over 6,750,000, comes next, having been almost stationary since 1898; Denmark and Sweden, with 4,250,000 each, also showing steady progress in the last ten years. The United States, which had nearly 3,000,000 tons in 1860, has not much over 1,750,000 for last year, although that was a far bigger return than any shown in the previous twenty years. France claims a little over 3,000,000 tons, and Russia rather more than 1,250,000.

British shipbuilding last year exceeded all previous figures, being 38,000 in sailing ships and 1,010,358 in steamers, a total of 1,048,448, the highest previously being 983,133 in 1901. Foreigners took from us 189,299 tons in steamers and 7,716 in sailers. This compares well with 330,316 tons built in the United States, and 10,894 tons were sold to foreigners. Germany built 105,408 tons (1904), bought 49,828 tons abroad, and sold to foreigners 87,565 tonnage.

The total mercantile marine of the United Kingdom is 10,554,520, and, with 1,601,581 tons belonging to our colonies, etc., the Empire total is 12,156,101 (an increase in five years of 1,500,000); while the United States has 5,540,374; Germany, having added over 1,000,000 tons in five years, is now 3,517,647; and Norway and France are both under 1,500,000.

The steam yacht Czarina, built two years ago by the Crescent ship yard, is having new Roberts safety water-tube boilers built to take the place of water-tube boilers of another type. The change is being made under the supervision of McIntosh' yacht agency. The boilers are now well under way at the works of the Roberts Safety Water Tube Boiler Co., at Red Bank, N. J. It is anticipated that they will be ready for installation inside of two weeks.

NATIONAL RIVER AND HARBORS CONGRESS.

The meeting of the National River and Harbors Congress at Washington last week was probably the most important gathering of a waterways association ever held in the United States. Delegates were present from all parts of the union, especially from the middle west. The utterances of President Roosevelt, who was called upon by a delegation at the white house, were especially notable. He said:

"Just as I feel that the national government should concern itself with utilization of the water of rivers in their sources, where the country is dry, so I feel the national government should concern itself with the proper control and utilization of the water lower down in the rivers, where they are fitted to be the great arteries of communication. I have had it brought strikingly to my attention but recently how much we suffer at present because of the inadequate transportation facilities of the railways for moving the great grain crops and cattle crop of this country. We need, and must have, further facilities for transportation, and, as has been well pointed out, one of the effective methods of affecting railway rates is to provide for a proper system of water transportation.

"It would not be possible for me to enter into any discussion of the details of your plan until I have spoken with some of the leaders of the two houses of congress. I shall consult with them at once, and trust that something definite and effective can be done along the lines of that you mention. You understand, gentlemen, I could not, offhand, commit myself to the details of any policy without taking into consideration what the feeling of the co-ordinate branch would be, and I must be guided largely by their views. I am sure that you will find there the genuine patriotic purpose to do what is best for the interest of our common country."

Resolutions were adopted urging congress to appropriate not less than $50,000,000 annually for the improvement of rivers, harbors and waterways, commencing with the present session of congress. In the preamble the resolution recites that some sure and adequate system of transportation must be added to the railroads and the development of the national highways was the only answer to the problem. Congress was asked in the resolution to put the rivers and harbor bill on the same footing as other regular appropriation bills.

The association is in a flourishing condition, as the report of Mr. J. F. Ellison, secretary and treasurer, indicated. The organization now embraces fifty-eight cities and twenty-nine states, having 161 separate associations and a total membership of 2,708.

The convention was called to order by its president, Mr. Harvey D. Goulder, of Cleveland, who addressed them as follows:

I took up this morning a newspaper which contained this statement:

> The Deep-water Convention is to be held in this city this week. From the results they get, they don't seem to draw enough water to need much deepening to be done. (Laughter.)

I will not detain you, with the distinguished speakers we have for this morning; but the problem for this convention is this: "If not, why not?" For this convention I do not hesitate to say that if that statement of the newspaper is true, then that great, big journal has not done its duty. If that statement be true, then you and I (and I see here the familiar faces of men with whom I have worked on matters of this sort for twenty-five years) have failed, either in judgment, or in effort, or in both.

I do not think that this convention represents a failure. I do not think it stands in any sense or in any degree for a failure. We have been having river and harbor appropriations; we have been spending the money. Young as I am, I have seen ships upon waters aided by government appropriations. I have seen them grow from five hundred tons in carrying capacity to near-fifteen thousand tons. In my time I have seen a commerce grow until, through channels which have been appropriately aided by the government, wisely and intelligently aided, there traveled last year five times as much commerce, five times as much net tonnage, five times as much actual freight, as Professor Johnson estimates would go through the Panama canal after it had been in operation for ten years. I have seen freights reduced from five dollars a ton to seventy cents a ton. I have seen, in the year 1906, in eight months of the year, the season now closing—I have seen and you may all see the saving over other methods of carriage upon the great lakes system of more than double all of the money that the government has ever invested in those improvements.

I do not speak for the great lakes. I hope we will not get into individual projects here. We ought not. Our strength would lie in other directions. But I have seen that, and so I take issue with the proposition that these movements are futile.

Now, what can we do? Here is the great, big, United States, like a young, lusty, energetic, optimistic business man, starting out. And we know, we who think (and I believe I am one of them) that we are starting out in this country, and we have got to make investments; and we have got, if it should be necessary, to go in debt in order to carry out our projects, just as any healthy, lusty, rational, good, strong, young business fellow does in his business. We have got to take those responsibilities.

Here we find a situation today of this character: You can scarcely ride on a passenger train and get to your destination at the schedule time. Why? Because they are too busy. Up in our region large contracts for the delivery of coal could not be carried out because they could not get the transportation. All the cars that all the manufacturers in the United States could make, working over-time, were ordered, and were being brought in; and they could not carry the coal. The same thing is true in respect to the iron ores. I speak of these things that come more particularly under my notice. I learn, as an incident of my business, purely, merely as an incident, that away up in the northwest the small local elevators along the railroads were filled, the farmers' barns and granaries were filled, and there is grain going to waste, splendid wheat going to waste, for which there is a market, simply because they cannot get the transportation. Those men cannot get it carried forward; and our ships at the shipping points on Lake Superior cannot get the grain. The grain exists, the market exists, the price is good, everything is favorable; and they simply cannot carry the stuff.

Now, here we go: Our members of congress, our speaker, our president, all of them are figuring about regulating the railroads, and regulating rates. We have our commission, and all that sort of thing. There is not a man who has enough interest and enough intelligence to attend a convention of this character who has not learned before he came here that the best possible regulator of rates, the safest regulator of rates, is to improve methods of water transportation. (Great applause.) And there is not a man who could gain admittance, accredited, to this room, who does not know that wherever there has been an intelligent and a reasonably liberal disposition of government investment in water transportation, there the results have shown the investment to have been a splendid investment. (Great applause.)

Now, I may not detain you, because I know that these other gentlemen ought to speak; and most of the men

in this room know of my identification for years with these things, and they could guess my views, perhaps better than I could express them. But I want to say this about what we ought to do; I want to say this about how we ought to meet this suggestion that we "do not draw water enough," this suggestion that we ought to have influence.

Now, here is where we stand. I can remember, back days and years ago, that there used to be talk about the "pork barrel," and that sort of thing. We have got, in our expending now of about twenty millions of dollars a year (we may call it the round figure, twenty millions a year) to a point, under the direction of our splendid corps of engineers, under our committees, with the chairmen of those committees (and while I do not want to be invidious in selecting individuals, and perhaps I am partial as being a "Tommy"), I think under the direction of Mr. Burton (applause), where the people of the United States who think, whose opinion is worth regarding, know and believe and say that that money which is expended now upon this character of improvement is spent intelligently, is spent honestly, is spent fairly. And though we be disappointed—I may go down through the great lakes, and go to advocate a lock at the Soo canal, or a channel in the Soo river, or a channel somewhere else, and not get it—I am willing to testify, after having gone before your rivers and harbors committee as now constituted, that I have never gone away from there, however disappointed in my hopes, with any other feeling than that I have been fairly and considerately treated; and I think you will all say that. (Great applause.)

Now, therefore, when it comes to the question of how much water we may draw, what we amount to, whether we are good for anything or not, whether we can have any influence or not, let us say this: That the money expended is well and is wisely and is honestly and is discreetly expended; and it is not enough. Can we educate the people of this country to such an extent that congress will dare (because they want to observe the wishes of the people, and they ought to) to put into the hands of those men, and into those channels of distribution which have evoked applause and confidence, not twenty million dollars a year, but fifty million dollars a year? (Great applause.)

We need the money. There is not a man here who does not know, there is not a man here who could not stand on this platform and demonstrate, that we need the money; and we ought to have the money. It ought to be expended. It is a good investment. The government cannot, by any shadow of possible peradventure, make a better investment than in that direction.

Now, are we men enough; is there enough to us; if we do not draw enough water, can we draw enough water, to make apparent that thing which we honestly, fairly, intelligently, upon study and upon consideration, know to be an absolute fact? Can we do it?

(A voice: "Sure we can!")

Now, I say, let us go at it—if we have been making any mistakes, if we have not been working right, if we have not been making due effort, let us do it; let us try to do it; and let us try to get this thing on its feet, try and get it where is ought to be, where we all know it ought to be, where it should be in honesty and justice.

Now, let me say in closing this: I do not think this is a good occasion (of course gentlemen attending this convention will do as they please and say what they like, because that is the American privilege)—I do not think this is the occasion to undertake, on any hand, to exploit any particular project. I think that we here would agree and would disagree about particular projects. I think each man here, representing some particular locality, would, if he deserves to live in his locality, rather think that his was the thing that ought to come first. I say, let us now as a convention, let us as intelligent, thoughtful men, let us as a lot of men who have come here at our own expense, because of our public interest in this matter—let us get together, and educate, try to make our impression on the congress of the United States and upon the people of the United States through this convention; let us try to convince them that we ought to have these more liberal appropriations; and then let us, so far as our projects are concerned, go with them into those channels where the money is now and has been distributed in a manner so satisfactory, as I have stated. (Great and long continued applause.)

The steamer John Harper, bound down with iron ore, ran into the ice in Portage Lake and had to return to Lily Pond, with a hole in the port side of her bow some 3 ft. long. The Harper is owned by the Gilchrist Transportation Co. of Cleveland.

COMMERCE OF ERIE CANAL.

New York's great waterway, the Erie canal, is losing none of its usefulness, according to the figures for 1906 business. The year closing has been a record breaker for the Erie canal in grain shipments and several other commodities. Figures on the total shipments compare well in all lines with the figures given out at the close of previous years. These figures show the great usefulness of the old waterway and that it is still a strong competitor of the railroads for business.

To the grain shipper, as the season comes to a close, comes the forcible impression of what the Erie canal's existence means to him. Buffalo elevators are filled with grain. Many thousands of bushels are held at the elevators in that city waiting shipment to the seaboard. Now that the canal is closed for the season this grain must go via the railroads if it goes before spring. When the rush of grain came along at Buffalo this year, as it always does about the close of navigation, the old waterway lent valuable assistance in relieving a congested state of affairs.

Following were the total shipments through the Erie canal during the season closed:

Eastbound—Wheat, 6,301,256 bushels; rye, 142,563; corn, 4,470,432; barley, 3,169,618; oats, 6,521,085; peas and beans, 5,834; flaxseed, 80,998,928 lbs.; pig iron, 15,147,700 lbs.; iron and steel bars and sheets, 923,440 lbs.; all other merchandise, stone, lime and clay, 627,519,500 lbs.; sundries, 1,437,460 lbs.; boards and scantlings, 88,053,832 ft.; total miles boats cleared, 667,618; number of clearances issued, 2,883.

Westbound shipments—Boards and scantlings, 81,758,047 feet; wood pulp, 274 lbs.; lard, tallow and lard oil, 184,000 lbs.; wheat, 94,000 bu.; corn, 2,180,600; barley, 96,000; oats, 2,077,000; hemp, 561,600 lbs.; clover and grass seed, 198,000 lbs.; hay, 360,000 lbs.; domestic spirits, 8,940 gallons; pig iron, 1,631,200 lbs.; sugar, 64,094,084 lbs.; iron and steel bars and sheets, 2,218,769; merchandise, 74,137,415 lbs.; stone, lime and clay, 768,646,919; sundries, 79,145,092 lbs.

The Anchor line has sold the well-known steamer Wissahickon to Collingwood interests, though retaining the right to name any future vessel of their fleet by that name. By the recent sale of the India and the abandonment of the Conemaugh, the Anchor line has now disposed of all of its wooden ships.

SCIENTIFIC LAKE NAVIGATION

By Clarence E. Long

When the course is expressed in degrees proceed as follows:

Mark the degrees of the true course R or L, according as they are right or left of N or S.

Underneath write the variation, marking it R or L, according as it is Wly. or Ely.

If the names are alike, take the sum, with that name, for the C. M. C.

When the sum amounts to 90° it is either E or W.

When the sum exceeds 90° take it from 180°, the remainder is the c. m. c., to be reckoned from the REVERSE point to that which the true course is reckoned from; also change the letter R to L, or L to R, that is, it is to be reckoned from the north if it had previously been reckoned from the south, but marked S, if previously marked N; also, if marked L (left) change to R (right), but if marked R change to L.

If the names are unlike, take the difference and mark it the same name as the greater.

If the variation, being subtractive, exceeds the amount from which it is to be subtracted, take the degrees of the course from the variation and name the remainder R or L, according as the variation is marked R or L.

Also remember that 0° is either north or south, as the case may be.

A few examples will explain the method:

Note.—Seconds of arc (") are discarded in this work, and should be in all practical work; when they amount to less than 30 they are not considered, but when 30 or more than 30 are called 1' and added in. In converting the course when expressed in degrees to its equivalent in points the course is taken to the nearest degree and fraction of a degree. By comparing the following examples this will be plainly seen.

The + and — signs are employed to make the work more plain and easy of comprehension.

The true courses are: NNE; S by W ½ W; WNW and SE ½ E, the variation in each case being 36° 30' Wly. What is the correct magnetic course in each case?

NNE=22° 30' R of N
Var. Wly. + 36° 30' R

C. M. C. 59° 00' R of N or N 59° E which in points is equal to NE by E ¼ E. (See table of Compass Angles, Lesson II.)

S by W ½ W=16° 53' R of S
Var. Wly. + 36° 30' R

Cor. mag. course 53° 23' R of S, or S 53° W, or S W ¾ W, being a 4¾-point course.

WNW=67° 30' L of N
Var. Wly. —36° 30' R

C. M. C. 31° 00' L of N, or N 31° W, or NNW ¾ W, being a 2¾-point course.

SE ½ E=50° 38' L of S
Var. Wly. —36° 30' R

C. M. C. 14° 8' L of S, or S 14° E, or S by E ¼ E, being a 1¼-point course.

The true courses are: N by E; S by W ¼ W; W ½ N; E by S; variation in each case 25° 19' Ely.:

N by E=11° 15' R of N
Var. Ely. —25° 19' L

C. M. C 14° 4' L of N, or N 15° W, being N by W ¼ W. Note.—Here the course is taken from the variation.

S by W ¼ W=14° 4' R of S
Var. Ely. —25° 19' L

C. M. C. 11° 15' L of S, or S 11° E, being S by E.

W ½ N =84° 23' L of N
Var. Ely. + 25° 19' L

C. M. C. —109° 42' L of N
180°

70° 18' R of S, or S 70° W, being WSW ¼ W, a 6¼-point course.

E by S= 78° 45' L of S
Var. Ely. + 25° 19' L

C. M. C. —104° 4' L of S
180°

75° 56' R of N, or N 76° E, being ENE ¼ E, a 6¾-point course.

The true courses are: NNE, variation 22° 30' Ely.; S by E, variation 11¼° Wly.; W by S, variation 11° 15' Wly.; and ESE, variation 22½° Ely.

NNE=22° 30' R of N
Var. Ely. —22° 30' L

0 0=North, a meridian [course.

S by E=11° 15' L or S
Var. Wly.—11° 15' R

0 0=South, a meridian [course.

W by S=78° 45' R of S
Var. Wly.+ 11° 15' R

C. M. C. 90° 0' R or S, S 90° W—an 8-point course.

ESE=67° 30' L of S
Var. Ely. +22° 30' L

C. M. C. 90° 0' L of S, or S 90° E, being east, also an 8-point course.

Note.——From what has been said it will be seen that in correcting courses for variation, the significance of RIGHT on the face of a compass card, is as the hands of a watch move over the dial, and LEFT the contrary direction.

SMALL ERRORS SOMETIMES MAKE LARGE ONES.

Note.—The student has probably discovered that in practice half a degree or less cuts but little figure, and so it does in some cases. But right here is a good time to say this: Errors may arise from neglecting small fractions in allowing for variation and deviation, and influence the reckoning. For instance: Supposing the case where the variation and deviation are of the same name, that is, both easterly or both westerly.

Var. Ely....3° 20' called ¼ point.
Dev. Ely.....6° 15' called ½ point

9° 35' ¾ point.

Now, 9° 35' is nearly equal to ⅞ of a point, whereas by neglecting the small fractions of a degree we get ¾ of a point, the difference being ⅛ point, and such small error in course may cause disaster, especially on long runs. A vessel making the run from Chicago to Pt. Betsey with an error of ⅛ point in the course will near Pt. Betsey 5 miles off her course, to the right or left, depending on the name of the error. Though this is a small error it amounts to a large consideration under certain conditions, and the navigator must take precautionary measures and guard against its liability of occurrence, for, as we have seen, it is possible for it to lead to serious trouble. Always bear this in mind when making allowances for the variation and the deviation in deducing one course to another. If the variation and deviation were of opposite names then these neglected fractions of a degree would offset or counteract each other, and no harm come of it. Let this suffice for the present, but in another chapter we will have more to say on this (neglected) subject.

FACTS WELL TO KNOW ABOUT FOG SIGNALS.

Do not think that you are out of hearing distance because you fail to hear a fog signal, nor that you are at a great distance because the sound is faint, nor that you are near because you hear the signal plainly.

It is important to know that sound is conveyed in a very capricious way through the atmosphere. Apart from wind or visible obstructions, large areas of silence have been found in different directions and at different distances from the origin of a sound, even in the very clearest of weather, and under a sky absolutely cloudless. Investigations have proven that sound is liable to be intercepted by streams of air unequally heated and unequally saturated with moisture. Under such conditions the intercepted vibrations are weakened by repeated reflections, and possibly may fail to reach the ear of persons well within the ordinary hearing limits. Experiments have also clearly shown that rain, hail, snow and fog have no power to obstruct sound; in fact, it has been shown that the condition of the air associated with fog is actually favorable to the transmission of sound.

You should not think that you have or have not reached a given point in your course because you do or do not hear the signal with the same intensity as on some former occasion. Neither should you assume that the signal has ceased sounding because you fail to hear it even when within easy earshot. It should also be borne in mind that the aberrations are not the same in different fog signals.

Do not expect to hear the signals as well as usually when the upper and lower air currents run in different directions, or during a time of electric disturbance, or when the sound must reach you from over an island or point of land.

When there is a bluff behind a signal, be prepared for irregular intervals in audition, as would follow were the sound to ricochet like a cannon ball; thus you might hear it at 2, 4, 6, 8, etc., miles, and lose it at 1, 2, 3, 5, 7, etc., miles, or at any other combination of distances, regular or irregular.

It must not be assumed that the zone of inaudibility of a fog signal is at all times the same, since its existence depends primarily upon the inequality of the currents of air in the atmosphere.

While the mariner may usually expect to hear a fog signal normally both as to intensity and place, he should take the foregoing into account, and be prepared for occasional aberrations in audition. Therefore, in approaching the land never rely solely and implicitly upon any fog signal, but heave your lead and use other means to make sure of your position.

Since the distance at which a fog signal can be heard is so variable and therefore unreliable under the variable conditions of the atmosphere mariners are strongly cautioned that they must not judge their distances by the power of the sound. Under certain conditions of the atmosphere the sound may be lost at a very short distance from the station, and these conditions are liable to and do vary at the same station within very short intervals of time. This is very easily accounted for.

It has been found that when approaching a fog signal from to-windward, its sound can be picked up earliest from aloft; and when approaching from to-leeward, the nearer one can get to the surface of the water the sooner it will be heard.

Fog is a vast multitude of minute globules of water in the air near the earth's surface. Fog may be produced in several ways, but it is usually caused by the cooling of saturated air, and the consequent condensation of a portion of its vapor. Illustrations of this may be observed daily. In winter, when our warm, moist breath passes from the mouth into the cold air, it is chilled and a portion of its vapor condenses into a visible mist. Mists frequently form over sheets of water in summer nights, because the neighboring land cools at night faster than the water, and thus cools the atmosphere in contact with it; this, in turn, chills the moist air over the water below its point of saturation, causing part of its vapor to condense into a mist. When the heat of the sun in the morning increases the capacity of the air for vapor, the mist evaporates and disappears. Mountain tops are frequently enveloped in mist because air currents, striking the mountain sides, are forced up the slopes into higher regions of the atmosphere, and thereby chilled below their point of saturation. The solid particles, or dust motes, in the air are great promoters of the formation of fogs, since they may radiate heat faster and thus become colder than the surrounding air, which is slightly cooled by contact with them. When this is the case, it is probable that each mist globule is formed around a dust mote, or is held firmly as a film surrounding each particle of atmospheric dust. The dryest road dust contains this moisture, which can only be removed by exposing it to a temperature of 212 degrees.

Clouds are merely fogs formed at some distance above the earth's surface. Clouds may be formed by radiation between warm and cold currents of air, but the chief causes of their formation are the mechanical cooling of an ascending current of air, and the cooling by radiation of a poleward-moving current of air. When air, whatever may be its temperature, is fully saturated with water, and will hold no more, it is said to be at the dew-point. Now, this point being reached, if the temperature be lowered in any way, the moisture loses its aeriform character, and is condensed into white vapor, termed cloud when high in the heavens, and mist or fog when near the earth's surface.

Every particle in nature absorbs moisture to some extent. Air is capable of taking up a certain amount of moisture, and of retaining it suspended in a perfectly invisible gaseous state. As a matter of fact, the ordinary atmospheric air we breathe contains at all times more or less water so suspended. The higher the temperature of the air, the greater its capacity for the retention of water in this invisible form. Escaping steam is another very good illustration of the formation of fog. Steam is nothing more than water at a high temperature in a gaseous state. It is quite invisible so long as it remains as such; but the moment it comes in contact with anything cold, it gets more or less condensed, and shows itself as a white vapor, or as it is sometimes called water-dust. Water may be seen boiling but steam is invisible. What we call steam is simply the condensation of heated water under the process of being rapidly cooled by two widely different temperatures. The water glass on a boiler affords another striking illustration of this phenomena. Steam after passing from the boiler and through the various parts of the engine finally enters the condenser, where it is at once chilled and rendered visible by a jet of cold water. There are many other conditions that might be named that cause fogs.

Fog is the great danger of navigation, and is probably one of the most serious difficulties with which the mariner has to contend. Probably 99 per cent of the strandings occur from this cause. In a majority of cases, at least, strandings are due to faulty methods of navigating in thick

weather. The ship's reckoning is not always properly taken into account, and this source of trouble is as much due to the lack of proper instruments on board ships necessary to accomplish this, as the lack of proper training on the part of the navigating officers.

No matter how accurate your compass may be, or how correctly you have set the course by an azimuth, or otherwise, it cannot counteract the effects of an unknown current, leeway and bad steering. The position of a vessel in thick weather can only be verified by soundings, and other aids, such as signals. The chief cause of stranding is the improper use of the lead, also in not using it at the right time. A high rate of speed in a fog is another cause of trouble. It shows not only poor judgment but criminal negligence as well, and cannot be justified by any process of reasoning whatsoever.

In our modern lake freighters, unless every course is set by an azimuth or by ranges, the course run cannot be depended upon in clear weather let alone in thick weather. How often it occurs that under the most favorable circumstances vessels will not make good a course. When I say favorable circumstances I mean a good working compass with the course set by an azimuth. When a vessel fetches wrong under these conditions it cannot be laid to the compass. If the course cannot be depended upon in clear weather it certainly cannot in thick weather. In clear weather errors in the course are easily guarded against. A bearing or two or the sight alone tells the story. In thick weather the compass and log cannot detect an error in the course any more than they can in clear weather, since each partake of the influences that set the vessel off the course supposed to be making good. Therefore, something must be provided that will accomplish in thick weather what bearings and the sight do in clear weather. It is found in the use of the patent sounding machine (chains of soundings, safety curves and the proper charts), in addition to compass and log. The study of problems of this description, on the correct solution of which frequently the safety of a vessel depends, is thoroughly neglected. The study of combining and using these instruments intelligently is one of the great secrets of successful coasting.

For the safety of a vessel in thick weather a patent sounding machine is as essential as the compass itself, and especially so when information from the bottom is needed. A patent sounding machine should be a part of the equipment of every vessel. Masters should call the attention of their owners to this valuable instrument. When its importance is once explained to him no owner with the right kind of business ability would refuse to install this instrument.

Soundings without system and a reliable basis is what leads to so many disasters, the numerous strandings in all parts of the world is proof thereof.

QUESTIONS FOR MASTERS AND MATES.—NO. 22.

325. The variation is six degrees westerly, the deviation four degrees westerly, the compass course is NE, what is the true course?

326. Am on the course from Chicago to Pt. Betsey, and after running 60 miles on the course find by an azimuth that compass course is ⅜ of a point in error, how many miles am I from the real course and how much must I alter course to counteract this error of ⅜ point? Figure this out without chart, parallel ruler, etc.

327. In a calm steaming 12 miles an hour steering SE, what is the apparent direction and force of the wind to those on board?

328. Wind from SW with a velocity of 11 miles an hour, what direction and velocity will the wind apparently be to those on board of a vessel steaming 11 miles an hour steering NE?

329. Wind north with a velocity of 25 miles an hour, what direction and velocity will the wind apparently be to those on board of a vessel steaming 12 miles an hour and steering due north?

330. Vessel steaming 10 miles an hour steering east, the apparent direction of the wind to those on board is south with a force of 20 miles, what is the true direction and velocity of the wind?

331. The compass course is NE and the correct magnetic course NE¾N, what is the deviation and which way is it?

332. Pitch of propeller wheel is 14 ft., what should speed of boat be per hour with engines making 90 revolutions per minute and no slip of wheel?

333. This same boat actually makes 12 miles an hour, how much is slip of wheel equal to and what is the percentage of slip?

334. Is the slip of the wheel as great running slow as when running fast?

335. A steamer making a speed of 10 miles per hour has a course of SW to make good, what must she steer in order to counteract a current setting NW at the rate of four miles an hour?

336. The true course is S by W, the deviation is ½ point easterly, and the compass course is S½W, how much is the variation and which way is it?

337. If you fetched to the westward of the course from Presque isle to Detour, how could you determine it from soundings in thick weather?

338. Why is it ordinarily that a boat makes better time going south along the west shore of Lake Huron than coming north?

339. How could you tell in clear weather whether your ship was being influenced by a current or not?

QUESTIONS FOR WHEELSMEN AND WATCHMEN.—NO. 23.

231. With stern of your boat on Vidal shoal channel ranges your steering compass reads WSW, how would you steer with same compass and boat in same trim from a point four miles north of Eagle harbor to a point two miles NxW½W from Devil island lighthouse?

232. What is the true bearing of Pt. Au Pins ranges?

233. If you had Vidal shoal channel ranges in line over stern of your boat, what land mark would you use for a turning point to bring head of your boat on Pt. Au Pins ranges?

234. Bound up and with Vidal shoal channel ranges over stern and heading WxS, the weather set in thick when abreast of Big Pt., how many points would you shift your boat so as to head on Pt. Au Pins ranges or nearly so?

235. If your steering compass reads SW½W heading on Pt. Au Pins ranges how would you steer with same compass and boat in same trim from a point two miles NxW½W from Devil island lighthouse to Duluth harbor entrance?

236. When abreast Foot's dock, bound up, Soo river, and heading SWxW on Pt. Au Pins ranges, how many points would you shift your boat so as to clear Pt. Au Pins?

237. Are Pt. Au Pins ranges on the mainland or on an island?

238. Bound up and abreast of Pt. Au Pins lighthouse, what land marks should you have in range?

239. When abreast of Pt. Au Pins lighthouse, bound up, you head SWxS, how many points would you shift and what land mark would you head on

until you got St. Mary's river lower ranges in line?

240. Give true bearing and distance of Cedar Pt. gas buoy from Pt. Au Pins lighthouse?

QUESTIONS FOR OILERS AND WATERTENDERS.—NO. 18.

170. What is the largest diameter allowed for a safety valve for marine boilers?

171. What will be the diameter of a safety valve for a boiler carrying 75 lbs. pressure with (2) furnaces five feet six inches long and three feet wide?

172. Required the working pressure on a cylindrical shell of a water-tube boiler: shell having holes four inches diameter spaced eight inches apart in a line from head to head. Material, one inch thick; diameter of shell, 20 in.; tensile strength, 60,000 lbs. per square inch.

173. What pressure would be allowed on a tubular boiler which had stood the initial hydrostatic test of 600 lbs. per square inch?

174. Of what construction must pipe mains for conducting water from fire pumps to loose connections be made of?

175. A circulating pump 11¼ in. diameter, 12-in. stroke, making 60 revolutions per minute, how many tons of sea water will it lift per hour, pump being 1-6 empty, each stroke?

176. A plunger 13 in. diameter has a travel of 181 ft. per minute, at what velocity will the water travel through a discharge pipe six inches diameter.

177. Two bunkers are to be built to hold 75 tons of soft coal, each bunker to be 14 ft. deep and six feet eight inches wide, what height must each be?

178. If the consumption of fuel is 1½ tons per hour to maintain a speed of 11 miles per hour, what will be the amount consumed during a run of 468 miles?

179. The consumption of coal per day is 25 tons, the average I. H. P. is 1,600, what will be the consumption per I. H. P. per hour?

FREIGHT SITUATION.

Navigation was seriously impeded this week by an ice blockade in St. Marys river and it looked as though a number of boats would be forced into winter quarters at the Sault. The barge Connelly Bros. blocked the channel at the dyke and large quantities of ice from Hay lake filled it to the bottom from the foot of the dyke to the turning point in Little Mud lake. Tugs were unable to make any impression upon it. President Harry Coulby, of the Pittsburg Steamship Co., after wiring Capt. W. W. Smith, marine superintendent in charge of operations for releasing the vessels, to use every means to get the fleet in motion, left for Sault Ste. Marie himself. Weather conditions moderated on Wednesday, however, and the channel was opened. It is likely to close again at any moment. Thirty-nine down-bound vessels were detained by the jam, while a number of up-bound coal vessels, originally consigned to the head of the lakes, were transferred to Lake Michigan ports. With the exception of a belated or fugitive cargo, the present week will see the close of navigation.

The market is closing very quietly indeed, though $1.60 has been paid on a few coal cargoes.

Following are the ore shipments by ports for November, and for the season up to Dec. 1:

Port.	Nov. 1905.	Nov. 1906.
Escanaba	630,463	748,912
Marquette	294,040	233,933
Ashland	426,346	284,507
Superior	468,827	626,633
Duluth	871,730	1,142,959
Two Harbors	649,823	697,223
	3,341,229	3,734,167
1906 increase		392,938

Port.	To Dec. 1, 1905.	To Dec. 1, 1906.
Escanaba	5,176,385	5,716,272
Marquette	2,925,250	2,743,219
Ashland	3,460,120	3,333,561
Superior	5,043,234	5,979,378
Duluth	8,767,706	11,098,175
Two Harbors	7,699,149	8,102,397
	33,071,844	36,973,002
1906 increase		3,901,158

Following were the grain shipments from Duluth for the week ending Dec. 8:

	Receipts.		Shipments.	
	Dec. 8.	Dec. 1.	Dec. 8.	Dec. 1
Wheat	1,438,389	2,246,364	3,917,290	2,672,592
Corn	....	....	....	....
Oats	73,510	68,975	305,573	176,533
Barley	340,816	488,524	679,807	741,200
Rye	9,230	18,420	161,441	....
Flax	820,876	1,304,985	2,989,800	734,450

STEAMER IRELAND STRANDED.

The steel steamer R. L. Ireland stranded on Gull Island Reef, Lake Superior, in practically the same place that the big steamer Wm. E. Corey went ashore in the big November gale last year. The Ireland stranded in a blinding snow storm while enroute to Duluth with a cargo of coal. The Ireland is a new boat, having been built in 1903. The tugs Crosby and Manistique went to the scene of the wreck at once, but were unable to do much owing to heavy weather.

Capt. James Reid, who has charge of the work of releasing the steamer Ireland, says that the steamer is in worse shape than the Corey was when she stranded at the same point last year. The vessel is on her entire length, but is not twisted. She lies on a bed of rock and boulders and one side is in bad shape, with tanks all punctured.

The steamer Wm. P. Snyder is in the Ecorse dry dock for repairs.

AROUND THE GREAT LAKES.

The Buffalo Transit Co. was incorporated last week to operate a line of steamboats.

Fire broke out in the steamer Walter Vail while enroute to Milwaukee, but the damage was slight.

The steamer Frontenac set in at Ecorse, having lost her smokestack in crossing Lake Erie.

The sunken steamer Comfort has been raised at Marine City and taken to Wallaceburg for repairs.

The Detroit & Buffalo steamer Western States was placed in the Detroit dry dock for rudder repairs last week.

Navigation closed at Marquette on the 10th by the sailing of the steamers Centurion and Livingstone for Cleveland.

The grand lodge of the Ship Masters' Association will hold its convention at Toledo during the last week in January.

While going in for shelter in the thick snow, the steamer Italia and barge Amazon grounded in the bay at Mackinaw City.

The steamer James Laughlin, which stranded twice on the Lime Kiln crossing last week, was taken to Detroit for survey.

The season of the Detroit & Cleveland Navigation Co. closed on Monday night. Both steamers are wintering in Detroit.

The Western Transit Co. has been awarded $5,000 for services rendered to the steamer Peter White while disabled in Lake Superior last year.

The Canadian Pacific railway has announced that it will build three new steamers for lake traffic between Fort William and Owen Sound.

The eight 600-ft. steamers of the Pittsburg Steamship Co. will winter at South Chicago. Placed end to end those eight steamers will reach nearly one mile.

The steamer Binghampton, of the Union line, bound down with package freight from Chicago, is ashore two miles northeast of Skillagalee light.

The executive committee of the Great Lakes Towing Co., has declared a dividend of 2 per cent on common stock to be paid January 15. Books close on Dec. 15.

The Pittsburg & Conneaut Dock Co., Conneaut, O., is putting in some concrete dock construction and is adding a large storage bridge to its present equipment.

The Merchants' Montreal Line of Montreal, which has purchased the Anchor line steamer India, will give the steamer a thorough overhauling this winter at considerable expense and will rename her City of Toronto.

BOOK REVIEWS.

Copper Work. A text book for teachers and students in manual arts, Augustus F. Rose, author. The Davis Press, Worcester, Mass., publishers. 118 page, 6 x 9. Price, $1.50.

In this work A. B. Rose, of the Providence Technical High School and Rhode Island School of Design, has endeavored to prepare a work helpful to teachers in the manual arts who are endeavoring to introduce metal work into the regular school course. The course is quite complete. The illustrations are both in line and half-tone, conveying their meaning well, while the test is elementary and clear. The first chapter is devoted to needful equipment. The requirements are simple and few tools are really necessary. The remaining chapters carry the student through various forms of design, notably escutcheons, draw pulls and hinges, finger plates, pad corners, picture frames, raised forms, spoons and the processes of polishing, embossing and enameling. There has been need in the market for some time for such a work as this, as inquiries at book shops have found their shelves innocent of any work dealing with this practice.

As "A Sailor of Fortune" we find in the personal memoirs of Capt. B. S. Osbon, by Albert Bigelow Paine, published by McClure, Phillips & Co., of New York, the strange and exciting incidents stretching over a career of eighty years that so delighted the readers of Pearson's Magazine, in which this narrative was first published. Born at Rye, N. Y., the son of a clergyman, young Osbon a mere matter of seventy years ago began his nautical career, running away from home, and starting as a mule driver on the Erie canal. This lacked in excitement and interest and he returned home, from which from time to time his roving disposition lured him away, and he made several voyages to the West Indies, preceding his more extended voyages in a whaler, his cruisings in the South Seas, his exciting adventures with the cannibals of that section of the world, and his final command of fighting launches along the coast of China, that were employed jointly by the British and Chinese governments to exterminate the pirates that infested those seas.

Anyone who has read Dana's "Two Years Before the Mast," and enjoyed it for its vivid delineation of sea life, forecastle yarns and picturesque and faithful descriptions of the early day conditions on the Pacific, before the gold fever developed, will find in Capt. Osbon's thrilling adventures a greater excitement, and all of the charm that has made Dana's classic so dear to the nautical-loving world. What Dana experienced in two years, Osbon multiplies by twenty, and from cover to cover of his book there is not a page that lacks in either interest or delight.

As the first naval editor of an American newspaper, the New York *Herald*, preceding the outbreak of the civil war, Capt. Osbon had opportunity for participation in many of the bloodiest and most glorious naval contests of that great contest. To this work he brought a ripe experience, the result of many hard knocks, in almost every part of the world, from a foremast hand to a commander. He had, in one year, explored the mysteries of the Arctic and of the Antarctic oceans, he had fought bloody battles with the fiercest and most reckless of Chinese and Malay pirates, he had barely escaped a "potting" by the South Sea cannibals, had almost reconciled himself to become a denizen of that remote portion of the world as a consort of a dusky bride, had fought in the civil war in Argentina, in command of an Argentinian rebel auxiliary cruiser, antedating our civil war, and had already had experiences enough to have satisfied even the most pronounced of roving dispositions.

As representative of the New York *Herald*, Capt. Osbon became acquainted with, and was able to show attentions to, the Prince of Wales, now King Edward VII, while he was in the United States, an acquaintance that has been continued until very recent times. He was on terms of intimacy with some of the greatest figures of the war of the rebellion, including President Lincoln, and Secretary of the Navy Welles, his stories of battles between union and confederate cruisers and forts covering many closely printed pages of the *Herald* during the exciting four years of that bloody war drama. With Farragut during his passage of the Mississippi and in the taking of New Orleans, he bore a conspicuous part, with the gallantry and the aplomb of an old-time veteran, and with the close of the civil war we find him as an admiral of the Mexican navy, fighting Maximillian, and helping to drive his adherents from American soil.

In his later years we find him engaged in the more peaceful pursuits of a lecturer, an editor and a publisher. He established the *Nautical Gazette* in 1871 and was its publisher and editor for many years. Earlier business interests called him to Europe, where his experiences in Mexico led to his acquaintance with Emperor Napoleon III, and to interesting and profitable experiences in France.

It would be impossible for one to attempt to describe the charm, vivid interest, breathless excitement, hairbreadth escapes, innumerable adventures that are described by Capt. Osbon with a naturalness and simplicity as delightful as they are unusual in these days of artificiality. To appreciate the briny in its vastness, the extent of old mother Earth and its seas, one must dip into "A Sailor of Fortune" again and again. From the earlier days of the notable clippers, the loggy old whalers, down to the "cheesebox" that forever destroyed the romance of the old "wooden walls," Capt. Osbon takes the reader by successive and rapid changes, holding the interest tensely and keenly throughout. It is impossible to properly and fully outline what the book contains within the limits of a review of this kind. We say again that one must have it and sit with it, thrilled over and over again, and to finish it with a sigh that the end has been reached, to enjoy it at its fullness.

It is our hope that, aged as he is, Capt. Osbon may again and again use his pen for the entertainment and instruction of his countrymen, and if in other "yarns" he can equal the vividness of description, succession of adventure and historical association the events he has but lightly touched upon in "A Sailor of Fortune" the world at large in general and his own country in particular will await the advent of what he has yet to say with a keen interest.

The big steel dredge which the Manitowoc Dry Dock Co. built for the Empire Engineering Co. of New York had a rough time in getting to Buffalo. The steamer Parks Foster took it as far as Detroit, where it was left to be pumped out, having shipped water in the heavy sea on Lake Huron. The steamer W. S. Mack undertook to tow it to Buffalo, but the tow line parted at Windmill Point and the dredge went adrift. The Mack circled the dredge for hours in an endeavor to get a line to it. The dredge kept slipping away, however, and help was finally summoned from Buffalo. The tug Cascade responded and finally succeeded in making a line fast to the dredge. The attempt was witnessed by hundreds in the office buildings of Buffalo.

Capt. Benjamin Boutell, of Bay City, who two years ago purchased the twelve whaleback steamers from the Pittsburg Steamship Co., has sold a controlling interest in the fleet to eastern parties. Two of the vessels were wrecked last year, so that the fleet now consists of ten vessels.

PRIVATE DINNERS ABOARD SHIP.

When the Caronia and Carmania were put into commission the excellence of the catering arrangements evoked as much praise from passengers as did the ships themselves, and their magnificent accommodation for all classes of travelers. The Cunard line, however, acting upon their traditional policy of keeping in the very fore front of the trans-Atlantic lines, has during the past few months inaugurated a further advance in taking further steps to enhance the comfort of first-class passengers, and one which affords another illustration of the fact that these Cunard vessels are floating hotels of the very first rank. The principle which was originally adopted in the Caronia and Carmania of departing from the usual long saloon tables has been extended, so that small parties consisting of five to twenty individuals can dine together. In catering for these social functions special menus are printed, the wishes of the party concerned being consulted as to the various courses, as they are in the case of a private dinner given at a hotel ashore. These menu cards which may be inscribed with a motto or legend indicative of the occasion are, needless to say, treasured by the guests as an interesting souvenir.

These dinner parties for which no extra charge is made are much appreciated by passengers, the increased facilities they provide for social intercourse on ship board adding much to the pleasures of a sea voyage.

The special dinners are only the outward and visible sign of Cunard enterprise in catering for their passengers. Chief stewards and head waiters have been put through a course of training in the leading hotels of London and Paris, and they in their turn have trained the different steward staffs to the highest possible degree of intelligent service. The arrangements for the preparing, cooking and serving of food on board the Caronia and Carmania are as perfect as can be, the cuisine arrangements of the London, continental and American hotels being carefully studied and the best principles of each adopted.

The cooking ranges are the largest yet made for any vessel and will only be eclipsed by those of the Lusitania and Mauretania. Potatoes are peeled and dishes are washed by machinery, joints, birds, game, etc., are roasted in special ovens, while the cold storage arrangements enable passengers to be supplied with all the delicacies of the season as fresh as when they came on board. With regard to the Lusitania and Mauretania the catering arrangements are receiving special attention and they will, as is to be expected from the size and magnificence of the ships, eclipse anything which has yet been attempted on ship board.

The following is one of many tributes which the Cunard Steamship Co. has received from passengers respecting the new vitualing arrangements.

This innovation takes the form of dinners a la carte which, under the able supervision of the catering department, and in the hands of an excellent chef, vie with those of the best restaurants of Paris, London and New York.

If they could add to the luxury already provided on the well-appointed ships of this fleet, these dinners must supply the want. Everyone feels that a well-cooked dinner served in a delightful way at his own hour is the crowning comfort of the day. The same time it affords an opportunity to entertain one's fellow travelers in a fashion second to none, there is little to be desired in the way of ocean travel. It is a departure which should meet with the success it deserves, more especially as it may be enjoyed without incurring any additional expense.

SCHULZ THORNYCROFT BOILER IN GERMAN NAVY.

We have received some particulars referring to the adoption of the Schulz-Thornycroft boiler in the German navy. This type of steam-generator was first adopted in 1896 for use on board torpedo craft, and has since been fitted on board cruisers and battleships. For a time large cruisers had the large-diameter tubes, but subsequent experience indicated that small diameter tubes gave more favorable results. All large cruisers recently built have exclusively Schulz-Thornycroft boilers. The battleships that have been constructed for the German navy since the introduction of the Schulz-Thornycroft boiler in these vessels have had the latter type in conjunction with cylindrical boilers, the older description prevailing; but those ships recently finished have 75 per cent of the steam generated supplied by the water-tube boiler in question; whilst all the battleships now in course of construction for the German admiralty have only the small-diameter Schulz-Thornycroft boiler. It is stated that the duration of life of the tubes is five years or more. The following figures refer to the boiler equipment of vessels of the German fleet, built or building. During the period of 1898-1908, there are, or will be, eighteen battleships, of 253,500 gross indicated horsepower, for which steam will be supplied by Schulz-Thornycroft boilers to the extent of 183,220 I. H. P., and by cylindrical boilers to the extent of 70,280 I. H. P. Large cruisers: period 1900-7, three in number, Schulz-Thornycroft boilers, 57,600 I. H. P.; cylindrical, 8,000. Period 1901-7, small cruisers, seventeen in number, Schulz-Thornycroft boilers, 167,000. Year 1900, one gunboat, Schulz-Thornycroft boilers, 1,350 I. H. P. Period 1898-1907, torpedo boats, nineteen in number, 90,850 I. H. P. Period 1898-1905, steam launches, eight in number, Schulz-Thornycroft boilers, 1,360 I. H. P. The total of vessels is therefore sixty-six, which are fitted with Schulz-Thornycroft boilers to the extent of 501,980 I. H. P., and with cylindrical boilers of 78,280 I. H. P. It will be seen, therefore, that the water-tube boiler has gradually superceded the cylindrical boiler in the German navy. Among other craft, the battleships to be exclusively fitted with the Schulz-Thornycroft boilers are the Pommeran, of 16,000 I. H. P. to be delivered in 1907; the "Q" and the Schlesien, each of 17,000 I. H. P., both to be delivered in 1908; and two cruisers, each of 26,000 I. H. P., both to be delivered in 1907. There is also to be delivered during 1907 a vessel described as a "torpedo-boat" of 10,000 I. H. P., which, like other torpedo craft under construction, will have Schulz-Thornycroft boilers exclusively.—*Engineering.*

GRAPHITE IN WINTER.

Almost any bearing that requires oil in it will work harder in winter than in summer, as the oil is bound to be more viscous when cold than when warm. It is for this reason that experienced men who have tried it suggest that a possible solution of difficulties in lubrication may be found in the use of flake graphite along with some thin mineral oil. The lubrication will be as good, if not better, and the drag and slowness will disappear.

The steamer James Laughlin was the first steamer to use the new channel on the west side of the Lime Kiln crossing. The big steamer was piloted through by the courtesy of the Dunbar & Sullivan Dredging Co. in loaning a tug. The new channel is 305 ft. wide and 21 ft. deep. It will not be formally opened to navigation until next year.

The steamers of the Detroit & Cleveland and Detroit & Buffalo lines will have a uniform appearance next spring. Their hulls will be black and upper works white.

A DREAM AND ITS ANALYSIS.

Editor MARINE REVIEW: I enclose you herewith a copy of a statement made by the late Commodore W. H. Wolf, of Milwaukee, which was extensively published at that time, March 1, 1877. Commodore Wolf was of that sturdy type of manhood that was in a measure responsible for the great growth of the lake traffic. He bore about the same relation to the wooden ship that your Mr. Robert Wallace, of Cleveland, bears to the steel ship. He was noted for his wit and repartee, and the "Barney" referred to here was a buggy horse that he had so trained, that a mere signal of the lines "Barney" would stand on his fore feet and kick a "democrat" or a man who got his work done at the rival ship yard, out of the buggy. There was considerably more competition in those days in ship building and repairs than at the present time.

Mr. Wolf was then at the head of Wolf & Davidson Ship Yard & Dry Dock Co., Milwaukee. The subject was given out as a "dream" but it occurs to me that it was more of an analysis of conditions made by a very clear-headed business man. In looking the matter over carefully recently it occurred to me that it was about time for some other clear-headed man to have a "dream" about the present conditions.

Very truly yours,

Chicago, Dec. 6 D. SULLIVAN.

WOLF & DAVIDSON SHIP YARD AND DRY DOCK, MILWAUKEE, WIS.

To Owners of Vessel Property.

TAKE COURAGE!

Our Mr. Wolf has had a dream, by which he explains that this is the last year of the hard times The dream, as related by him, is as follows:

"I dreamed I was sitting in my buggy and watching three wagons passing by on the road which were so heavily laden with gold that they fairly groaned, and the earth trembled under their weight.

"After they had passed by, I heard a terrible crash, and behold! They had collapsed and caused a blockade of the whole thoroughfare, bringing all traffic to a sudden standstill.

"The three teamsters wished to ride with me, and I being always ready to help the public when in trouble, especially when there seems to be a job ahead, invited them to a seat in my buggy; but, after they had embarked, 'Barney' commenced kicking rather fiercely, and, not liking the looks of his heels, they concluded to get out, and I was satisfied that 'Barney' was right, for my buggy would not have been strong enough to carry such a load.

"As I was drawing up the lines to start 'Barney', there came along on the same road five teams with wagons, their wagons being nearly empty. I asked the teamsters of the five, 'why did you not load like the wagons which have just collapsed?' They answered and said, 'we have learned a lesson by what has happened. It will take five of us to clear up the blockade caused by the three who were overloaded, and hereafter all who heed the lesson taught by the overloading of the three wagons and their consequent collapse may be benefited thereby.'

"I awoke, and found it was morning, and, being busy, thought no more of my dream. But this winter, having little or nothing to do, the dream again came to my mind, and after a long study, I have concluded to interpret it in this wise:

"The three wagons heavily laden with gold were three years, viz: A part of '70, and years '71, '72 and a part of '73. The collapse of the three wagons was the 'panic', which will not be forgotten by vessel owners and the public generally. The five wagons that followed and cleared up the 'breakdown' represent the five years following, viz: Part of '73, and the years '74, '75, '76 and '77; and the clearing of the road indicates and promises that we will begin, toward the latter part of this year, doing business on a sound and reasonable basis. The three men who were trying to ride with me represent the vessel men, who, allowing themselves to be overloaded in good times, got into difficulties, and while we were carrying them, came very near getting us into the same trouble with themselves; but as 'Barney' kicked them out before the buggy broke, we hope to weather the storm."

Since the hard times are soon to end, we hope you will take courage, and keep up your vessels. And should you see fit to put any of your work into our hands, you may rest assured that we will endeavor to give you perfect satisfaction. Having shared your difficulties and hard experiences, we will be satisfied with small profits.

There is no doubt that the larger the vessels are, the better they will be enabled to compete with railroads; and believing that ship yards and dry docks are no exception to this general rule of competition, we have extended our facilities by using machinery wherever practicable. We have in our establishment all kinds of machinery of the latest improvements, thereby being able to do a greater amount of work for less money than any other establishment on the lakes.

Your attention is particularly called to the following facts:

1. We have in running order the only dry dock on the lakes where a loaded vessel drawing 15 ft. of water can be docked.

2. The only ship yard on the lakes having both stationary and floating dry docks.

3. The only ship yard on the lakes that can dock six vessels at one time, including one of 3,000 tons.

4. The only dry dock on Lake Michigan where vessels can be towed from the lake without passing through a bridge.

5. The only steam hammer connected with any ship yard blacksmith shop on the lakes.

6. The only chain factory connected with any ship yard on the lakes.

7. The only Daniels' planer connected with any ship yard on the lakes. This planer saves an immense amount of work, doing both hewing and planing, from an inch board to timber 24 in. square, 60 ft. long. All our knees are sided with this machine.

8. The only ship yard on the lakes having a steam derrick for hoisting spars, boilers, etc.

9. The largest side-wheel steamers can be docked without removing wheels.

10. The only dry dock that we know of, or have heard of, having waterworks connected with the dock proper, so that men working on the bottom of a vessel can refresh themselves with a drink—of Lake Michigan water—without leaving the dock.

11. The only horse, "Barney", that can kick any person out of the buggy who gets his work done at any other yard. If you don't believe it—try it.

Besides the above we have all improvements found in any ship yard, such as bevel and cut-off saws, steam forges, steam bolt cutters, and, in fact, all machinery needed for doing work quickly and cheaply.

We think the foregoing will convince you that we possess unsurpassed facilities for doing work in an economical and first-class manner, and we assure you that in making the foregoing claims as to our facilities, we are not dreaming —they speak for themselves.

Thanking you for the very liberal patronage heretofore bestowed upon us, and trusting to receive like favors in the future, and assuring you that all work entrusted to us will receive our personal attention, and that we will use our utmost endeavors to give perfect satisfaction, we are, etc.,

WOLF & DAVIDSON.

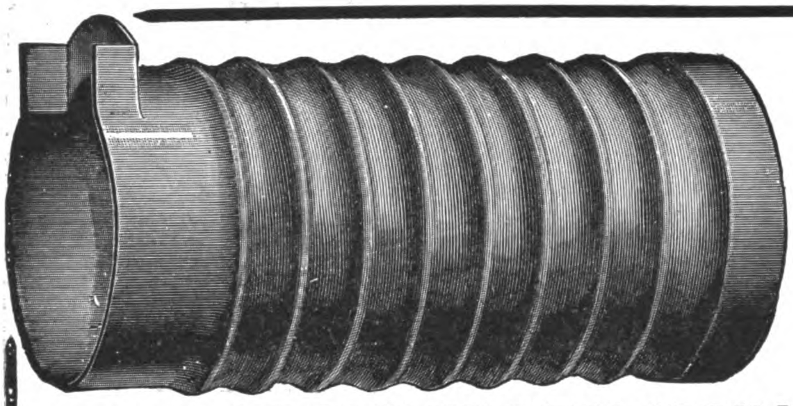
Yard south of the harbor.

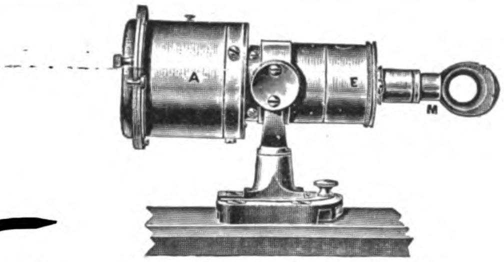
Orders received at tug office.

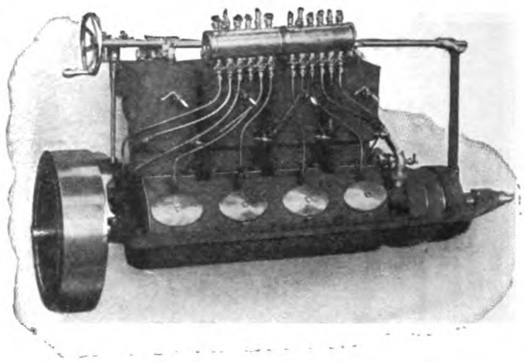
Mr. H. A. Flagg has been appointed as manager of sales of the Shelby Steel Tube Co. in charge of the New York office.

THE MARINE REVIEW

VOL. XXXIV. CLEVELAND, DECEMBER 13, 1906. NO. 24.





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PROPOSALS

U. S. Engineer Office, Vicksburg, Miss., Nov. 20, 1906. Sealed proposals for the construction of six wooden, four creosoted or three steel material barges for use in the Third district, improving Mississippi River, will be received at this office until 12 o'clock, noon, Dec. 20, 1906, and then publicly opened. Information furnished on application. G. M. Hoffman, Capt. Engineers.

FOR SALE.

TALK WITH BRADLEY. — Before buying or selling a boat. I have vessels of most every kind—from 10 tons to 6,000 tons—to sell for owners. Anybody wishing to buy or sell boats should call or write.

Fred A. Bradley,
11 Mooney-Brisbane Bldg.,
Buffalo, N. Y.
Insurance Agent.

VERTICAL ENGINE.

One triple-expansion marine type vertical engine, 11¼-inch, 18-inch, 29 x 18-inch stroke. Inquire, Public Lighting Commission, No. 40 Atwater Street East, Detroit, Mich.

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Five Scotch Boilers, allowed 160 lbs, steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg, Cleveland, O.

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1,000 h. p. fore and aft Neafie & Levy compound Engine; surface condenser; independent pumps.

Two 12-foot Scotch Boilers.

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Three 150-h. p. Almy Boilers.

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One 14 30 x 24 fore and aft Engine and condenser.

One Williamson steering Engine.

One 10 k. w. electric lighting Set.

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One Providence Windlass, 50 fathoms 1½ in. chain.

Two thrust Shafts and Bearings, 8½ in. diameter.

MARVIN BRIGGS,
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Steamer for Sale Cheap.

The lighthouse steamer Haze, 145 ft. long, 27-ft. beam, 9-ft. draught, 500 tons capacity, 300 horsepower engine and boiler, suitable for passenger or freight business, fully equipped. Steam capstan, donkey boiler. Jacob Ullman, 46 Lloyd street, Buffalo, N. Y.

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CHICAGO STEAMER EXCHANGE,
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WANTED.—Photograph of schooner "Porter," formerly sailed by Capt. Geo. McLeod of Buffalo. Address J. A. Coy, MARINE REVIEW, Cleveland, O.

WANTED TO BUY FOR CASH Passenger Boat, length 70 to 80 ft. Beam 16 to 18 ft., light Draft. Must be good runner, single deck preferred. In writing give full description of Hull, boiler and engines. Address L. E. Eggert, Muskegon Heights, Mich.

WANTED.—A good stone scow, about 800 tons capacity or over. Give particulars and price. Apply Box 106.

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WANTED.—For charter entire season 1907, packet type boat, 1,000 to 1,200 tons capacity; draught not over 14 ft. loaded, to ply between Bay City and Chicago and Lake Superior points with cement cargoes.

BOILER WANTED.

WANTED.—One second-hand Scotch boiler, 160 lbs. pressure; dimensions preferred 15 ft. diameter, 10½ ft. long. Delivered New York. Answer
S. S. D. Box, Care MARINE REVIEW, Cleveland, O.

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One fore and aft Compound Marine Engine with cylinders 27 and 50 by 40-inch stroke. Inquire of the Montague Iron Works, of Montague, Mich.

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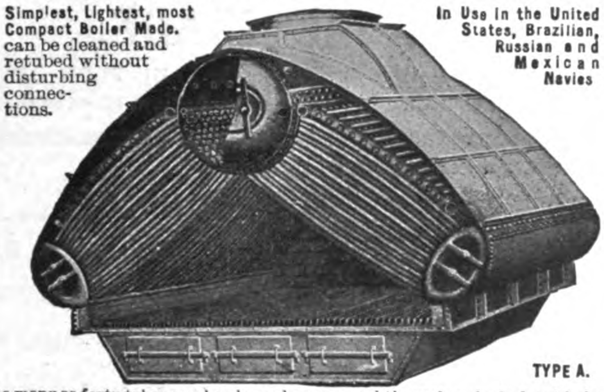

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As many as forty tubes can be cleaned or renewed through a single hand-hole; has greater steam and water capacity than any other water tube boiler. Send for descriptive catalogue.

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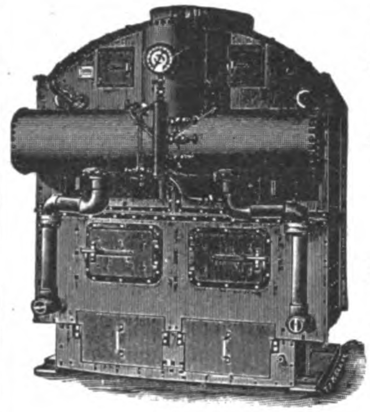

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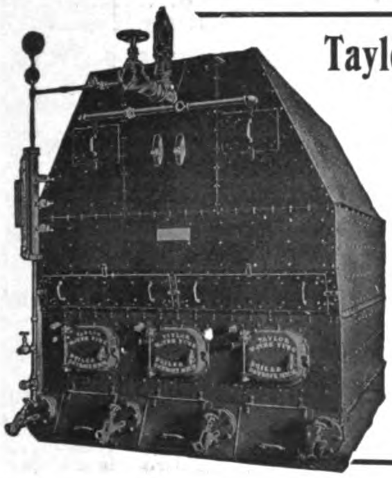

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Vertical Tubes, sectional, large steam space and liberating area.
Fire box, combustion chamber, and course for the furnace gases similar to the Scotch Marine.
Free circulation type.

Send for full description.

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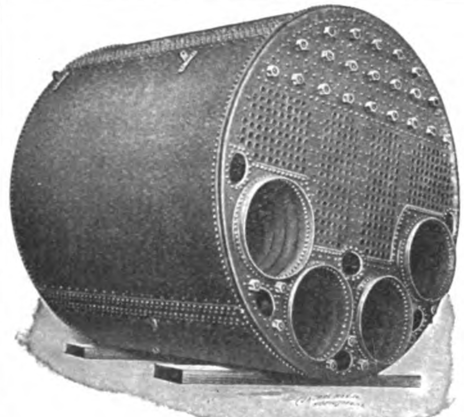

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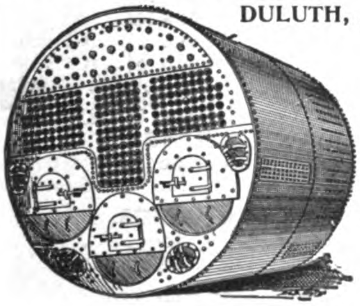

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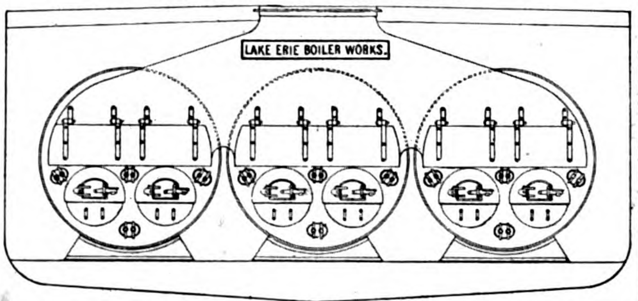

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Large Supplies of Best Quality.

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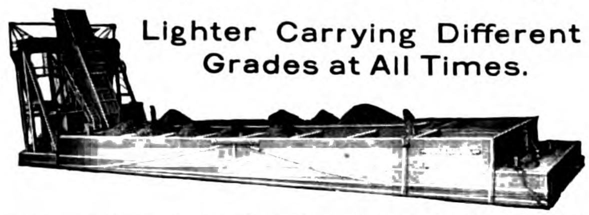

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Kremer, C. E. ....Chicago.
MacDonald, Ray G.........Chicago.
Maytham, Frank.............Buffalo
Shaw, Warren, Cady & Oakes...... .... Detroit.
White, Johnson, McCaslin & Cannon ....Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons.............. ....Brookline, Mass.

BENDING MACHINES
Cleveland Punch & Shear Works Co. .... Cleveland.

BLOCKS, SHEAVES, ETC.
Boston Lockport Block Co........ ....Boston, Mass.

BLOWERS.
American Blower Co., Detroit, Mich.

BOAT BUILDERS.
Drein, Thos. & Son................ ....Wilmington, Del.
Kahnweiler's Sons, David.......... ....New York.
Truscott Boat Mfg. Co............. ....St. Joseph, Mich.

BOILER COMPOUNDS.
The Bird-Archer Co......New York
Dearborn Drug & Chemical Works.. ....Chicago.
State Manufacturing Co...Cleveland.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co........ ....Providence, R. I.
American Ship Building Co......... .... Cleveland.
Atlantic Works..East Boston, Mass.
Briggs, Marvin..........New York.
Chicago Ship Building Co..Chicago.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fletcher, W. A. & Co............. ....Hoboken, N. J.
Fore River Shipbuilding Co........ ....Quincy, Mass.
Great Lakes Engineering Works.... .... Detroit.
Kingston Foundry & Machine Works ....Oswego, N. Y.
Lake Erie Boiler Wks.......Buffalo
Maryland Steel Co.................. ....Sparrow's Point, Md.
McLaughlin Iron Wks ..Ashtabula, O.
Milwaukee Dry Dock Co.......... ....Milwaukee.
Mosher Water Tube Co..New York.
Newport News Ship Building Co.. ....Newport News, Va.
New York Shipbuilding Co.......... .... Camden, N. J.
Northwestern Steam Boiler & Mfg. Co............. ....Duluth, Minn.
Ohio Machine & Boiler Co......... .... Cleveland.
Quintard Iron Works Co.......... ....New York.
Roberts Safety Water Tube Boiler Co. ....New York.
Superior Ship Building Co........ .... Superior, Wis.
Taylor Water Tube Boiler Co.... .... Detroit.
Toledo Ship Building Co.......Toledo.

BOILER RIVETS.
Bourne-Fuller Co.........Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.......... ....Cuyahoga Falls, O.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons.....Philadelphia.
Fore River Ship & Engine Co...... ....Quincy, Mass.
Great Lakes Engineering Works.. .... Detroit.
Lunkenheimer Co........Cincinnati.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co.... ....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co............... Cleveland.
G. H. Williams Co........Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co........Cleveland.

CANVAS SPECIALTIES.
Baker & Co., H. H.........Buffalo.
Bunker, E. A...........New York.
Upson-Walton Co.........Cleveland.

CAPSTANS.
American Ship Windlass Co........ .... Providence, R. I.
Dake Engine Co.................... ....Grand Haven, Mich.
Hyde Windlass Co........Bath, Me.
Marine Mfg. & Supply Co.......... ....New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co................ ....Jersey City, N. J.

CHAIN SURVEYORS, HOISTS.
Brown-Hoisting Machinery Co...... ....Cleveland.
General Electric Co................ ....Schenectady, N. Y.

CHAIN HOISTS.
Boston & Lockport Block Co...... .... Boston, Mass.

CHARTS.
Penton Publishing Co....Cleveland.

CHECK VALVES.
Scoville Check Valve Co., Ashtabula, O.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ritchie, E. S. & Sons.............. .... Brookline, Mass.

CLOTHING, WATERPROOF.
Armstrong, E. A. Mfg. Co...Chicago.

COAL PRODUCERS AND SHIPPERS.
Hanna, M. A. & Co........Cleveland.
Pickands, Mather & Co....Cleveland.
Pittsburg Coal Co........Cleveland

COAL AND ORE HANDLING MACHINERY.
Brown-Hoisting Machinery Co...... ....Cleveland.

COMPASSES.
Ritchie, E. S. & Son............... .... Brookline, Mass.

CONDENSERS.
Great Lakes Engineering Works.... .... Detroit.
Wheeler Condenser & Engineering Co.................... New York.

CONTRACTORS FOR PUBLIC WORKS.
Breymann Bros., G. H.......Toledo.
Buffalo Dredging Co.........Buffalo.
Dunbar & Sullivan Dredging Co.... ....Buffalo.
Great Lakes Dredge & Dock Co.... .... Chicago.
Hickler Bros......... ....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H... .... Milwaukee.
Standard Contracting Co..Cleveland.
Sullivan, M................ Detroit

CORDAGE.
Baker & Co., H. H..........Buffalo.
Upson-Walton Co.........Cleveland.

Buyers' Directory of the Marine Trade.—*Continued.*

CORK JACKETS AND RINGS.
Armstrong Cork Co..Pittsburg, Pa.
Kahnweiler's Sons, D....New York.

CRANES, TRAVELING.
Brown-Hoisting Machinery Co....... Cleveland.

CUTTING OFF MACHINES.
Cleveland Punch & Shear Works Co. .... Cleveland.

DIVING APPARATUS.
Morse, A. J. & Son........Boston.
Schrader's Son, Inc., A..New York.

DREDGING CONTRACTORS.
Breymann & Bros., G. H....Toledo.
Buffalo Dredging Co........Buffalo.
Dunbar & Sullivan Dredging Co.... Buffalo.
Great Lakes Dredge & Dock Co.. Chicago.
Hickler Bros. ....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich.
Starke Dredge & Dock Co., C. H... ....Milwaukee.
Sullivan, M.................Buffalo.

DREDGING MACHINERY.
Quintard Iron Works Co.New York.
Superior Iron Works...Superior, Wis.

DRILLING MACHINES.
Cleveland Punch & Shear Works Co. .... Cleveland.

DRY DOCKS.
American Ship Building Co........ Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co......Buffalo.
Chicago Ship Building Co.......... Chicago
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co.......... Detroit
Great Lakes Engineering Works.... Detroit.
Lockwood Mfg. Co.............. East Boston, Mass.
Milwaukee Dry Dock Co........... Milwaukee.
Newport News Ship Building Co... Newport News, Va.
Superior Ship Building Co........ Superior, Wis.
Tietjen & Lang Dry Dock Co...... Hoboken, N. J.
Toledo Ship Building Co......Toledo.

DYNAMOS.
General Electric Co............... Schenectady, N. Y.

ELECTRIC HOISTS AND CRANES.
General Electric Co............... Schenectady, N. Y.

ELECTRIC LIGHT AND POWER PLANTS.
General Electric Co................. Schenectady, N. Y.

ENGINE BUILDERS, MARINE.
American Blower Co., Detroit, Mich.
American Ship Building Co......... Cleveland.
Atlantic Works, East Boston, Mass.
Briggs, Marvin..........New York.
Chicago Ship Building Co., Chicago.
Chase Machine Co........Cleveland.
Cramp, Wm. & Sons, Philadelphia.
Detroit Ship Building Co., Detroit.
Fletcher, W. & A. Co., Hoboken, N. J.
Fore River Shipbuilding Co......... Quincy, Mass.
Great Lakes Engineering Works.... Detroit, Mich.
Hall Bros. .... Philadelphia.

ENGINE BUILDERS—Continued.
Lockwood Mfg. Co................ East Boston, Mass.
Maryland Steel Co................. Sparrows Point, Md.
Milwaukee Dry Dock Co., Milwaukee.
Mosher, Chas. D.........New York.
Newport News Ship Building Co.... Newport News, Va.
New York Ship Building Co........ Camden, N. J.
Northwestern Steam Boiler & Mfg. Co. .... Duluth, Mich.
Quintard Iron Works Co., New York.
Roach's Ship Yard......Chester, Pa.
Sheriffs Mfg. Co.........Milwaukee.
Superior Ship Building Co.......... Superior, Wis.
Thropp, J. E. & Sons Co........... Trenton, N. J.
Toledo Ship Building Co......Toledo.
Trout, H. G................Buffalo.

ENGINE ROOM TELEGRAPH CALL BELLS, ETC.
Cory, Chas. & Son......New York.
Marine Mfg. Supply Co., New York.

ENGINEERING SPECIALTIES AND SUPPLIES.
Lunkenheimer Co. ...... Cincinnati.
Northwestern Steam Boiler & Mfg. Co. .... Duluth, Minn.

ENGINEERS, MARINE, MECHANICAL, CONSULTING.
Furstenau, M. C......... Philadelphia.
Hynd, Alexander .... Cleveland.
Hunt, Robt. W. & Co......Chicago.
Kidd, Joseph..........Duluth, Minn.
Mosher, Chas. D........New York.
Nacey, James .... Cleveland.
Roelker, H. B...........New York.
Wood, W. J................Chicago.

FANS.
American Blower Co., Detroit, Mich.

FEED WATER PURIFIERS AND HEATERS.
Ross Valve Co..........Troy, N. Y.
Wheeler Condenser & Engineering Co. .... New York.

FIXTURES FOR LAMPS, OIL OR ELECTRIC.
General Electric Co................ Schenectady, N. Y.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.
Cleveland City Forge & Iron Co.... Cleveland.
Fore River Shipbuilding Co......... Quincy, Mass.

Ohio Machine & Boiler Co......... Cleveland.

FLUE WELDING.
Fix's S. Sons............Cleveland.

FUELING COMPANIES AND COAL DEALERS.
Hanna, M. A. & Co......Cleveland.
Parker Bros. Co., Ltd......Detroit.
Pickands, Mather & Co., Cleveland.
Pittsburg Coal Co........Cleveland.
Smith, Stanley B., & Co., Detroit.
Toledo Fuel Company, ...Toledo, O.

FURNACES FOR BOILERS.
Continental Iron Works, New York.

GAS BUOYS.
Safety Car Heating & Lighting Co.. .... New York.

GAS AND GASOLINE ENGINES.
Chase Machine Co........Cleveland.

GAUGES, STEAM AND VACUUM.
Lunkenheimer Co. ...... Cincinnati.

GAUGES, WATER.
Lunkenheimer Co......Cincinnati, O.

GENERATING SETS.
General Electric Co................ Schenectady, N. Y.

GRAPHITE.
Dixon Crucible Co., Joseph.......... Jersey City, N. J.

HAMMERS, STEAM.
Chase Machine Co........Cleveland.
Cleveland Punch & Shear Works Co. .... Cleveland.

HEATING AND VENTILATING APPARATUS.
American Blower Co., Detroit, Mich.

HOISTS FOR CARGO, ETC.
American Ship Building Co.......... Cleveland.
Brown Hoisting Machinery Co...... Cleveland.
Chase Machine Co.......Cleveland.
Dake Engine Co.................... Grand Haven, Mich.
General Electric Co......New York.
Hyde Windlass Co........Bath, Me.
Marine Iron Co............Bay City.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co.......... Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works.... Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The......... New York.

ICE MACHINERY.
Great Lakes Engineering Works.... Detroit.
Roelker, H. B...........New York.

INJECTORS.
American Injector Co......Detroit.
Jenkins Bros............New York.
Lunkenheimer Co. ...... Cincinnati.
Penberthy Injector Co............. Detroit, Mich.

INSURANCE, MARINE.
Atlantic Mutual Insurance Co........ New York.
Belcher, Fred P...........Winnipeg.
Elphicke, C. W. & Co......Chicago.
Gilchrist & Co., C. P.....Cleveland.
Hawgood & Co., W. A., Cleveland.
Helm & Co., D. T..........Duluth.
Hutchinson & Co.........Cleveland.
McCarthy, T. R..........Montreal.
McCurdy, Geo. L..........Chicago.
Mitchell & Co............Cleveland.
Parker Bros. Co., Ltd......Detroit.
Peck, Chas. E. & W. F............ New York and Chicago.
Prindiville & Co...........Chicago.
Richardson, W. C........Cleveland.
Sullivan, D. & Co..........Chicago.
Vance & Joys Co.........Milwaukee.

Buyers' Directory of the Marine Trade---*Continued.*

IRON ORE AND PIG IRON.
Bourne-Fuller Co......Cleveland, O.
Hanna, M. A. & Co........Cleveland.
Pickands, Mather & Co., Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co...............St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong Cork Co......Pittsburg.
Carley Life Float Co...............New York, N. Y.
Drein, Thos. & Son............... Wilmington, Del.
Kahnweiler's Sons, D.....New York.

LOGS.
Nicholson Ship Log Co., Cleveland.
Walker & Sons, Thomas............ Birmingham, Eng.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph...............Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ...... Cincinnati.

LUMBER.
Martin-Barriss Co. ...... Cleveland.

MACHINISTS.
Chase Machine Co........Cleveland.
Hickler Bros., Sault Ste. Marie, Mich.
Lockwood Mfg. Co...............East Boston, Mass.
McLaughlin Iron Works, Ashtabula, O.
Ohio Machine & Boiler Co............... Cleveland.
Superior Iron Works.Superior, Wis.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc....Philadelphia

MARINE RAILWAYS
Hickler Bros., Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF,
Crandall & Son, H. I...............East Boston, Mass.

MARINE TORCHES.
Marine Torch Co..........Baltimore.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W.............New York

MECHANICAL DRAFT FOR BOILERS.
American Blower Co., ...Detroit.
American Ship Building Co....................... Cleveland.
Detroit Ship Building Co., Detroit.
Great Lakes Engineering Works.......................... Detroit.

METALLIC PACKING.
Katzenstein, L. & Co., New York.

MOTORS, GENERATORS—ELECTRIC.
General Electric Co................Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons................. Brookline, Mass.

NAVAL ARCHITECTS.
Curr, Robert ....Cleveland
Hynd, Alexander ....Cleveland
Kidd, Joseph ....Duluth, Minn.
Mosher, Chas. D.........New York.
Nacey, James ....Cleveland
Wood, W. J...............Chicago

OAKUM.
Stratford, Oakum Co.................Jersey City, N. J.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph................Jersey City, N. J.

PACKING.
Jenkins Bros............New York.
Katzenstein, L. & Co...New York.

PAINTS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co........Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc. ..Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co........Buffalo.
Dunbar & Sullivan Dredging Co.... Buffalo.
Great Lakes Dredge & Dock Co.... Chicago.
Hickler Bros..Sault Ste. Marie, Mich.
Hubbell Co., H. W...Saginaw, Mich.
Parker Bros. Co., Ltd.......Detroit.
Starke Dredge & Dock Co., C. H.......Milwaukee.
Sullivan, M.................Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co......Cleveland, O.

PLANERS.
Cleveland Punch & Shear Works Co. .... Cleveland.

PLANING MILL MACHINERY.
Atlantic Works, Inc....Philadelphia.
Cleveland Punch & Shear Works Co. .... Cleveland.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co......Cleveland, O.
Otis Steel Co...........Cleveland.

PRESSURE REGULATORS.
Ross Valve Co.........Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co.............................. Cleveland.
Atlantic Works ..East Boston, Mass.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fore River Shipbuilding Co.................. Quincy, Mass.
Great Lakes Engineering Works.... Detroit.
Hyde Windlass Co........Bath, Me.
Lockwood Mfg. Co.............East Boston, Mass.
Milwaukee Dry Dock Co.........Milwaukee.
Newport News Ship Building Co................Newport News, Va.
Roelker, H. B..........New York.
Sheriffs Mfg. Co........Milwaukee.
Superior Ship Building Co....................Superior, Wis.
Thropp & Sons Co., J. E....................Trenton, N. J.
Toledo Ship Building Co......Toledo.
Trout, H. G................Buffalo.

PROJECTORS, ELECTRIC.
General Electric Co.............Schenectady, N. Y

PUNCHES AND SHEARS.
Cleveland Punch & Shear Works Co. .... Cleveland.

PUMPS FOR VARIOUS PURPOSES.
Great Lakes Engineering Works.. Detroit.
Kingsford Foundry & Machine Works ....Oswego, N. Y.
Wheeler Condenser & Engineering Co. ....New York.
Roelker, H. B..........New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register......Cleveland.

RIVETS, STEEL FOR SHIPS AND BOILERS.
Bourne-Fuller Co.......Cleveland, O.
Great Lakes Engineering Works.... Detroit.

SAFETY VALVES.
Lunkenheimer Co.........Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co........Cleveland.

SALVAGE COMPANIES.
See Wrecking Companies.

SEARCH LIGHTS.
General Electric Co...............Schenectady, N. Y.

SHEARS.
See Punches, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co......Cleveland, O.
Otis Steel Co...........Cleveland.

SHIP BUILDERS.
American Ship Building Co......... Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co.......Buffalo.
Collingwood Shipbuilding Co.,...... Collingwood, Ont.
Cramp, Wm. & Sons..Philadelphia
Chicago Ship Building Co..Chicago.
Detroit Ship Building Co....Detroit.
Fore River Ship Building Co....... ..Quincy, Mass
Great Lakes Engineering Works.... Detroit.
Lockwood Mfg. Co...............East Boston, Mass.
Maryland Steel Co.............Sparrow's Point, Md.
Milwaukee Dry Dock Co.......... Milwaukee.
Newport News Ship Building Co...............Newport News, Va.
New York Shipbuilding Co.......Camden, N. J.
Roach's Ship Yard.....Chester, Pa.
Toledo Ship Building Co......Toledo.

SHIP CHANDLERS.
Baker, Howard H. & Co....Buffalo.
Marine Mfg. & Supply Co........ New York
Upson-Walton Co........Cleveland.

SHIP DESIGNERS.
Kidd, Joseph ....Duluth.
Steel, Nacey, & Hynd....Cleveland
Wood, W. J...............Chicago

SHIP FLOORING.
Clemente, The C., Co....Cleveland.

Buyers' Directory of the Marine Trade---*Continuea.*

SHIP LANTERNS AND LAMPS.
Upson-Walton Co.......... Cleveland.

SHIP TIMBER.
Martin-Barriss Co.........Cleveland.

SHOES.
Emerson Shoe Co. ......Cleveland.

SIGNALS—SUBMARINE.
Submarine Signal Co...........Boston

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co.................................Jersey City, N. J.

STAYBOLT IRON OR STEEL BARS, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.........................Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Holmes, Samuel ....New York.
McCarthy, T. R.....Montreal, Can.

STEAMSHIP LINES, PASS, AND FREIGHT.
American Line ....New York.
Boston Steamship ....Boston.
C. & B. Transit Co...........Cleveland.
International Mercantile Marine Co. .... Philadelphia.
Mallory Line ....New York.
New York & Cuba Mail S. S. Co.. ....New York.
Red Star Line ....New York.
Ward Line ....New York.

STEEL CASTINGS.
Otis Steel Co............Cleveland.

STEERING APPARATUS.
American Ship Building Co....................... ......Cleveland.
Chase Machine Co.......Cleveland.
Dake Engine Co...............................Grand Haven, Mich.
Detroit Ship Building Co....Detroit.
Hyde Windlass Co........Bath, Me.
Marine Mfg. & Supply Co.......... ....New York.
Sheriffs Mfg. Co........Wilwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J..........Boston.
Schrader's Son, Inc. A....New York.

SURVEYORS, MARINE.
Hynd, Alexander ....Cleveland.
Parker Bros. Co., Ltd......Detroit.
Nacey, James ....Cleveland.

SURVEYORS, MARINE—Continued.
Steel, Adam ....Cleveland.
Wood, W. J...............Chicago.

SYPHONS.
Philip Braender....New York City.

TESTS OF MATERIALS.
Hunt, Robert W. & Co....Chicago.
Lunkenheimer Co....Cincinnati, O.

THERMIT
Goldschmidt Thermit Co., ... New York City.

THREAD CUTTING TOOLS.
Armstrong Manufacturing Co. ....Bridgeport, Conn.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Watson-Stillman Co......New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc....Philadelphia.

TOWING MACHINES.
American Ship Windlass Co.......................Providence, R. I.
Chase Machine Co.......Cleveland.

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co.. ....Kingston, Ont.
Great Lakes Towing Co..Cleveland.

TRUCKS.
Boston & Lockport Block Co...... .... Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co..Pittsburg, Pa.

VALVES, STEAM SPECIALTIES, ETC.
Jenkins Bros. ....New York
Lunkenheimer Co........Cincinnati.
Ross Valve Co.........Troy, N. Y.

VALVES FOR WATER AND GAS.
Ashton Valve Co.,..........Boston.
Lunkenheimer Co........Cincinnati.
Ross Valve Co........Troy, N. Y.
Scoville Check Valve Co........................ Ashtabula, O.

VESSEL AND FREIGHT AGENTS.
Billett, T. R...............Winnipeg.
Boland, John J.............Buffalo.
Douglas, G. L. Jr............Duluth
Elphicke, C. W. & Co......Chicago.
Hall, John B................Buffalo.
Helm & Co., D. T.........Duluth.

VESSELS AND FREIGHT AGENTS—Con.
Hawgood & Co., W. A....Cleveland.
Holmes, Samuel ....New York.
Hutchinson & Co.........Cleveland.
McCarthy, T. R...........Montreal.
Mitchell & Co............Cleveland.
Parker Bros. Co., Ltd......Detroit.
Prindiville & Co............Chicago.
Richardson, W. C.........Cleveland.
Sullivan, D. & Co..........Chicago

WATER GAUGES.
Lunkenheimer Co.....Cincinnati, O.

WHISTLES, STEAM.
Lunkenheimer Co........Cincinnati.

WILFORD'S WATERPROOF CLOTH.
Bunker, E. A........... New York

WIRE ROPE AND WIRE ROPE FITTINGS.
Baker, H. H. & Co..........Buffalo.
Upson-Walton Co.........Cleveland.

WINDLASSES.
American Ship Windlass Co........ .... Providence, R. I.
American Ship Building Co........ .... .Cleveland.
Dake Engine Co...............................Grand Haven, Mich.
Hyde Windlass Co........Bath, Me.
Marine Mfg. & Supply Co....... ....New York.

WINCHES.
American Ship Windlass Co...........................Providence, R. I.
Hyde Windlass Co........Bath, Me.

WOOD WORKING MACHINERY.
Atlantic Works, Inc....Philadelphia.

WRECKING AND SALVAGE COMPANIES.
Donnelly Salvage & Wrecking Co.. .... Kingston, Ont.
Great Lakes Towing Co..Cleveland.
Parker Bros. Co., Ltd.......Detroit.

YACHT AND BOAT BUILDERS.
Drein, Thos. & Son................................ Wilmington, Del.
Truscott Boat Mfg. Co...............................St. Joseph, Mich.

YAWLS.
Drein, Thos. & Son............................ .Wilmington, Del.

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Attorney and Counsellor at Law
Proctor in Admiralty.
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John F. Wedow, Doan 141-J.
Alfred Mitchell, Doan 218.

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